ILLINOIS WATERWAY
U.S. Army Corps of Engineers, Rock Island District
Rock Island
Rock Island
Illinois

HAER IL-164
IL-164

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
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HISTORIC AMERICAN ENGINEERING RECORD

ILLINOIS WATERWAY

HAER No. IL-164

Location: The Illinois Waterway stretches approximately 336 miles in total length from Chicago to Grafton, Illinois. It runs along the Calumet-Sag Channel, the Chicago Sanitary & Ship Canal, and the Des Plaines and Illinois rivers. This report covers that section of the waterway extending from Chicago to La Grange Lock and Dam near Versailles in Brown County, Illinois.

Construction Dates: Various; Lockport Lock and Dam, Brandon Road Lock and Dam, Dresden Island Lock and Dam, Marseilles Lock and Dam, and Starved Rock Lock and Dam were in operation by the opening of the waterway in 1933; Peoria Lock and Dam and La Grange Lock and Dam were in operation by 1939; Thomas J. O'Brien Lock and Control Works was the last to be completed in 1960 and to be put into operation in 1965.

Engineer/Builder: Various, see individual histories for information

Present Owner: U.S. Army Corps of Engineers, Rock Island District

Present Use: Navigation, shipping

Significance: The Illinois Waterway fulfilled a long time need in the Midwest for a navigable route linking Lake Michigan with the Mississippi River and beyond. The waterway is made up of Ohio River Standard Navigation locks with vertical lift, miter and sector gates, and dams with Tainter, vertical lift, and Chanoine wicket gates. The various lock gate and dam gate types are the result of evolving technologies and reveal the influence of the Panama Canal on the first stage of the waterway's development. The waterway is significant not only for its role in transportation and industry in the Midwest but also for its extant wicket and Tainter gates.

Historian: Justine Christianson, HAER Historian, 2008

Project Information: The Illinois Waterway Recording Project (2007-2008) was undertaken by the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER is administered by Heritage Documentation Programs, a division of the National Park Service, U.S. Department of the Interior, Richard O'Connor, Manager. The U.S. Army Corps of Engineers (USACE) funded the project. Ron Deiss, USACE, and Dana Lockett, HAER Architect, served as project managers. Dana Lockett and Anne

Kidd, HAER Contractor, produced the measured drawings. Large format photography was done by Brian Grogan. Justine Christianson wrote the historical reports. Research assistance was provided by John Fitzgerald, Archivist, USACE.

For information on the individual lock and dam sites making up the waterway, see:

Illinois Waterway, La Grange Lock and Dam	HAER No. IL-164-A
Illinois Waterway, Peoria Lock and Dam	HAER No. IL-164-B
Illinois Waterway, Project Office	HAER No. IL-164-C
Illinois Waterway, Starved Rock and Dam	HAER No. IL-127, HAER No. IL-164-D
Illinois Waterway, Marseilles Lock and Dam	HAER No. IL-164-E
Illinois Waterway, Dresden Island Lock and Dam	HAER No. IL-164-F
Illinois Waterway, Brandon Road Lock and Dam	HAER No. IL-164-G
Illinois Waterway, Lockport Lock and Dam	HAER No. IL-164-H
Illinois Waterway, Thomas J. O'Brien Lock and Control Works	HAER No. IL-164-I

INTRODUCTION

The Illinois Waterway extends approximately 336 miles from Chicago and the mouth of the Chicago River at Lake Michigan to the mouth of the Illinois River near Grafton, Illinois. It also links to the Calumet region via the Calumet-Sag Channel. The waterway follows the channel of the Chicago Sanitary & Ship Canal and extends down the Des Plaines River and then the Illinois River to its mouth at the Mississippi River near Grafton. The waterway drops from 578' above sea level at Lake Michigan to 419' above sea level at Grafton, Illinois. To accommodate this drop, locks and dams were constructed at Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria and La Grange, as well as a control works on the Calumet-Sag Channel. This report focuses on the planning, engineering and building of that section of the waterway that extends from Chicago and the Thomas J. O'Brien Lock and Control Works on the Calumet-Sag Channel to the La Grange Lock and Dam near Versailles in Brown County, Illinois on the Illinois River. The regional network of waterways that were incorporated into the Illinois Waterway or preceded it will also be discussed as part of the waterway's contextual history.[1]

The construction history of the Illinois Waterway can be divided into three phases. The first phase was undertaken by both the State of Illinois and the U.S. Army Corps of Engineers and ended with the opening of the waterway in 1933. It included the construction of a lock at Lockport and locks and dams at Brandon Road, Dresden Island, Marseilles, and Starved Rock. The second phase, solely under the authority of the Army Corps, ended with the 1939 opening of the Peoria and La Grange locks and dams. The third phase, lasting from 1957-1965, involved the construction and eventual opening of the Thomas J. O'Brien Lock and Control Works by the Army Corps. These three phases of development utilized different technologies. The 1930s-era locks generally adhered to the Ohio River Standard with 110' x 600' chambers and steel miter gates. The exception was the new lock at Lockport, whose location dictated the use of a vertical lift gate at the upper end. The later Thomas J. O'Brien lock dating to 1960 had a 110' x 1000' chamber and sector gates. The dams differ according to the phase of construction as well. Those built in the first phase (including Brandon Road, Dresden Island, Marseilles and Starved Rock) utilized Tainter gates, while those in the second phase (Peoria and La Grange) had Chanoine wickets. The control works at Thomas J. O'Brien was designed with vertical lift sluice gates. The different phases of construction also resulted in the use of various "styles" for the control houses, including Georgian Revival detailing in the first phase, Art Deco in the second, and International in the third. There are, of course, minor variations at each lock and dam site due to the variable settings and topographies. A brief description of each lock and dam site is included below in the "Current Description" section. For a complete history and description of each lock and dam site, see the individual histories, the HAER numbers for which are provided at the beginning of this report.

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[1] For a detailed survey of the system and its structures as it existed in 1996, see Mary Yeater Rathburn, American Resources Group, Ltd., "Architectural and Engineering Resources of the Illinois Waterway Between 130th Street in Chicago and La Grange, Illinois," Volume II, prepared for the U.S. Army Corps of Engineers, Rock Island District, Rock Island, Illinois, October 1996. Volume I of that report provides background information on the design, development, and construction of the waterway.

CURRENT DESCRIPTION

The Illinois Waterway is a slack water navigation system, which can best be described as looking like a stairway in profile.[2]

Starting at Chicago, the first lock on the waterway is the Thomas J. O'Brien Lock and Control Works, located at East 130th Street in Chicago on the Calumet-Sag Channel. Completed in 1960, the lock and control works were put into operation in 1965 after the closure of the Blue Island Lock and Control Works. The lock has sector gates at both ends of its 110' x 1000' chamber. It has a 4' lift. The 93' long, reinforced concrete, fixed dam has four single-leaf, vertical lift, submergible sluice gates. A brick control station and other auxiliary structures added throughout the site's operational history make up the Thomas J. O'Brien site.

The Lockport Lock and Dam site is located on the Chicago Sanitary & Ship Canal. A lock, dam and power plant were originally built at the site in 1905 as part of a nearly 2 mile extension of the canal. The concrete dam featured a bear trap sector gate, while the original lock had wooden miter gates both upstream and down and reinforced concrete and earth tailrace and guide walls. In 1923, the state of Illinois began building a new lock at Lockport. This lock differs from others on the waterway because of the single-leaf, vertical lift floating gate located at the upstream end rather than a miter gate. The vertical lift gate was needed for the 39' lift at this site, the highest on the waterway.[3] The *Chicago Daily Tribune* declared the Lockport lock to be the "highest lift lock in the world of that size" in 1928.[4] It is now thought to "have the only known operating single-leaf, submergible, vertical lift, floating lock gates in the country."[5] In addition to the brick control house, there are a number of other auxiliary structures that have been added to the site throughout its operational history.

Brandon Road Lock, on the Des Plaines River, has a 34' lift and 110' x 600' chamber. Steel miter gates are located at each end of the chamber. The 2,373' long dam is connected to the upper guide wall by an ice protection wall. The dam has twenty-one Tainter gates, along with six sluice gates and sixteen vertical lift headgates. The sluice gate openings have been concreted

[2] The analogy to a stairway comes from William Patrick O'Brien, Mary Yeater Rathburn, and Patrick O'Bannon, edited by Christine Whitacre, *Gateways to Commerce: The U.S. Army Corps of Engineers' 9-Foot Channel Project on the Upper Mississippi River* (Denver: National Park Service, Rocky Mountain Region, 1992), pp. 12-13. They state: "the 'treads' are the slack-water lakes, or navigation pools, created by a series of dams across the river. The 'risers' are the locks which, through their changing water levels, carry the boats from one pool to the next."
[3] Lift measurements vary for each lock. Those used in this report come from the U.S. Army Corps of Engineers, Rock Island District.
[4] "70 Chicagoans Inspect Locks in Illinois River," *Chicago Daily Tribune*, October 5, 1928, p. 3.
[5] Barbara J. Henning, "Lockport Lock, Dam and Power House Historic District," National Register of Historic Places Nomination Form, 2001, Section 7, p. 1. The 1996 American Resources Group survey form states that Lockport Lock "has the highest lift in the system. It is the only known operating historic lock with single-leaf, submergible vertical-lift floating gates. It is a rare intact example of an historic application of a lock gate technology appropriate to very high lift lock gates," see Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume II, p. 53. The Rathburn survey (p. 53) gives the lift at Lockport as 40' while other sources say 41' (see U.S. Army Corps of Engineers, *The Illinois Waterway* (Washington, DC: U.S. Government Printing Office, 1930), p. 43; M.G. Barnes, "The Illinois Waterway," *Journal of the Western Society of Engineers* XXVI, no. 5 (May 1921): p. 176; "The Illinois State Waterway for Barge Navigation," *Engineering News-Record* 85, no. 23 (December 2, 1920): p. 1096).

into a partly open position while eight of the headgates have been concreted into a closed position. The ice chute has been converted for use as overflow. Brandon Road Dam is unique among the other dams on the waterway because of the electric hoists used to operate the eight remaining headgates. Three stationary electric hoists were mounted on the easternmost headgates, while a movable electric hoist car on a rail system operates the remaining five vertical lift headgates. The hoists were necessary to quickly open the gates in instances of high water entering the Des Plaines River from the Chicago Sanitary & Ship Canal. The Illinois Waterway runs through the center of the city of Joliet prior to reaching the Brandon Road Lock and Dam. Although enclosed by 4 miles of reinforced concrete walls in that section, high waters could potentially flood the city if not quickly released at the Brandon Road Dam. In addition to the brick control house and auxiliary structures associated with the operation of the lock and dam, there are several buildings onsite operated by the Army Reserve.[6]

The next lock and dam on the Illinois Waterway is at Dresden Island on the Illinois River. The Dresden Island Lock, with a 21.75' lift, is unique on the Illinois Waterway because an incomplete auxiliary lock is adjacent to the main one. The state started construction of the auxiliary lock in the 1920s but abandoned it due to a lack of funding and changes in how the site was to be operated. The incomplete lock consists of partially built walls and a concrete arch dam. The main lock has steel miter gates at both ends of the 110' x 600' chamber. The dam measures nearly 1,506' long and has fourteen single-leaf, vertical lift headgates, a concrete ice chute, nine Tainter gates and a concrete spillway. A boiler house, located above the ice chute, contains the boiler used to thaw the dam gates in freezing temperatures. In addition to the brick control house, a number of auxiliary structures have been constructed on the site throughout its operational history.[7]

The topographic conditions at the site of the Marseilles Lock and Dam necessitated the greatest deviation from the standard plan directing the development of the waterway's original lock and dam sites. Rapids on the Illinois River in this location resulted in the construction of a 2-1/2 mile long diversion canal measuring 200' wide and 9' deep to carry the waterway around this treacherous area. The dam is also unusual on the waterway because it was constructed as three discontinuous segments. The 76' long south headrace dam has one Tainter gate. This dam was built to control the flow of water in the south headrace channel used by the nearby Nabisco factory. The south headrace dam's Tainter gate had the notable distinction of being twice as long as the average Tainter gate built in 1933. The north headrace dam, measuring 144' long, contained two Tainter gates, which were also significant for their large size. The north headrace dam controlled the flow of water rushing into the north headrace channel, which was used by the 1906 Marseilles Hydroelectric Plant. The main dam, nearly 599' long, has eight submergible Tainter gates and a concrete ice chute. A dam boiler house was located on top of the main dam and held the boiler for thawing out the dam gates in freezing temperatures. The lock has a 24.25' lift and steel miter gates at both ends of its 110' x 600' chamber. Other structures include the brick control house and auxiliary buildings, that have been added to the site throughout its operational history.[8]

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[6] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume II, pp. 117-125.
[7] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume II, pp. 201-209.
[8] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume II, pp. 269-281.

Starved Rock Lock and Dam site is located on the Illinois River. The lock has an 18.7' lift and steel miter gates at both ends of its 110' x 600' chamber. The 1,310' long dam has ten vertical lift gates (installed in anticipation of hydroelectric power being generated at the site) and a spillway made up of a concrete ogee-curved weir with ten Tainter gates. At the time of its construction, the Tainter gates (19' x 60') were considered some of the largest in operation. Between the headgates and spillway is a 30' concrete ice chute. Atop the dam is a boiler house to keep the dam gates operable in freezing temperatures. In addition to the brick control house, auxiliary buildings were constructed at the site throughout its operational history.[9]

A harbor and marine ways were built in 1912-13 in Peoria, Illinois, and later incorporated into the Illinois Waterway Project Office. Various buildings were added to the site in the 1920s and 1930s, including a pattern storage building (ca. 1922), and storehouse, shops, garage, and paint sheds (all ca. 1930s). Other buildings have been added throughout its operation. A number of boats are stored at the site, including Derrick Boat No. 3 (a 1936 work barge), the PEKIN (a ca. 1943 metal work boat), ATLAS (a ca. 1950 work barge), PEORIA (a 1963 push boat), and Barge No. 8 (a 1989 work barge).[10]

The next lock and dam site on the waterway is at Peoria. The River and Harbor Act of 1935 authorized the construction of a modern lock and dam at Peoria and La Grange to replace obsolete ones at Henry and Copperas Creek. These two modern locks would maintain a navigable channel of at least 9' depth and 300' width below Lockport. The lock at Peoria has a 10' lift and steel miter gates at both ends of its 110' x 600' chamber. The dam has the distinction of being one of the last remaining Chanoine wicket gate dams in the country, along with La Grange Lock and Dam. Measuring 536' long, the concrete dam has 108 wicket gates and one Tainter gate, installed in 1986 to replace twenty-six of the wickets located at the landward end. Maneuver Boat No. 2, a work barge, raises and lowers the wickets using a permanently mounted, steam-operated gate lifter. The SANGAMON, a 1972 push boat with a diesel engine, pushes Maneuver Boat No. 2 into position. The brick control house is identical to that at La Grange. A number of auxiliary structures have been added to the site throughout its operational history.[11]

La Grange Lock and Dam, located on the Illinois River, replaced an 1889 lock at this site in 1939. It is nearly identical to Peoria Lock and Dam. The lock has a 10' lift like Peoria and steel miter gates at both ends of the 110' x 600' chamber. The 1,066' long dam has 109 Chanoine wicket gates and one Tainter gate, which replaced twenty-eight of the wicket gates at the landward end in 1990. Maneuver Boat No. 1, a work barge, raises and lowers the wickets using a Caterpillar brand excavator with a hook on the end of the bucket, a modification dating to the 1990s. The 1972 BEARDSTOWN pushes Maneuver Boat No. 1 into position. A number of auxiliary structures have been added to the site throughout its operational history.[12]

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[9] Cynthia de Miranda and Charlene Roise, "Starved Rock Lock and Dam," HAER No. IL-127, pp. 4-5; Rathburn, "Architectural and Engineering Resources," Volume II, pp. 339-345.
[10] Rathburn, "Architectural and Engineering Resources," Volume II, pp. 405-437.
[11] Rathburn, "Architectural and Engineering Resources," Volume II, pp. 445-455.
[12] Rathburn, "Architectural and Engineering Resources," Volume II, pp. 503-517.

Other facilities located along the Illinois Waterway that were not part of the HAER documentation project include Goose Lake Pump House and Copperas Creek Lock. Goose Lake Pump House, located on the Kankakee River, was constructed in 1934 to house three electric pumps needed to alleviate drainage issues caused by the construction of Dresden Island Lock and Dam. Copperas Creek Lock, located on the Illinois River, dates to 1877 and was built by the Army Corps and the state. The lock chamber was 75' x 350' and had miter gates at both ends. A 640' dam originally extended from the west side of an island in the river, but the Army Corps removed it and the lock gates in 1928. Remnants of this lock exist, but the site has been abandoned.[13]

REGIONAL WATERWAY DEVELOPMENT

The Illinois Waterway was one component of a regional network of waterways that early twentieth century planners envisioned connecting the Great Lakes (specifically Lake Michigan and Chicago and its environs) with the Mississippi River and ultimately New Orleans and the Gulf of Mexico. By the mid-twentieth century, the Illinois Waterway connected Lake Michigan via the Chicago Sanitary & Ship Canal, Des Plaines and Illinois rivers to the Mississippi River, as well as the Calumet region via the Calumet-Sag Channel. The Illinois Waterway project was part of a larger initiative by the federal government to create a 9' channel on the Illinois and Mississippi rivers, thus creating navigable routes on the nation's inland waterways.

The history of the Illinois Waterway dates to at least the seventeenth century as American Indians established the route that the waterway would eventually follow. Early navigation was hampered by the continental divide (known as the Chicago Portage) separating the watersheds and waterways flowing east to Lake Michigan and those flowing southeast to the Mississippi River. For example, the Des Plaines River, which merges with the Kankakee River at Joliet, Illinois to form the Illinois River, is located to the west of the divide and flows to the Mississippi River. The Chicago River's South Branch, on the other hand is located to the east of the divide and flows to Lake Michigan. Rocky cuts and swampy land resulting from glacial activity further complicated navigation. Nevertheless, American Indians had established a route navigating this area that would later become the Illinois Waterway. European explorers like Louis Joliet (a French-Canadian explorer) and Father Pierre Marquette (a Jesuit missionary) followed this American Indian route. Their 1673 journey took them on the Illinois and Des Plaines rivers, where they came upon the Chicago Portage. After portaging over the swampy divide, Marquette and Joliet followed the Chicago River to Lake Michigan. Marquette wrote to Father Claude Dablon, Superior General of the Jesuit Order at Montreal who oversaw the exploration, that a canal or cut should be made from the Illinois River into the St. Louis River. Joliet and Marquette recognized the importance of a waterway connection between Lake Michigan and the Mississippi River, but it would be many years and involve much planning and political

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[13] See Mary Yeater Rathburn, American Resources Group, Ltd., "Architectural and Engineering Resources of the Illinois Waterway Between 130th Street in Chicago and La Grange, Illinois," Volume I, prepared for the U.S. Army Corps of Engineers, Rock Island District, Rock Island, Illinois, October 1996, pp. 40-41, 83, 87, and Volume II, pp. 193, 487.

maneuvering before such a waterway would be realized.[14]

The 1808 Gallatin Report, issued by Albert Gallatin who served as Secretary of the Treasury from 1801-14, contained the results of his survey of existing routes in the United States. The report recommended building a canal across the Chicago Portage so that the Great Lakes could be linked to the sea via the Chicago and Mississippi rivers. In 1810, Congress adopted a resolution supporting Gallatin's recommendation but no movement was made towards its implementation.[15] The War of 1812 further increased interest in creating water routes to inland lakes for defense purposes. Although President James Madison approached Congress in 1814 asking for authorization to build a canal between Lake Michigan and the Illinois River, Congress had instead turned its attention to a waterway route through the Ohio River Valley due to the area's higher population and the fact that steamships were already plying the Ohio River to New Orleans.[16]

As a result of the increasing recognition of the usefulness of canals in this part of the country, a number of plans for canals traversing the area that would later be served by the Illinois Waterway were developed, with a handful actually being built. Canal development was aided by American Indians ceding a 20 mile stretch of land from Lake Michigan to the Fox River, including the Chicago River, in 1816 to the U. S. government in exchange for the promise of Illinois Territory Governor Ninian Edwards that a canal would be built, among other things.[17] That same year, the War Department sent Brev. Maj. Stephen Harriman Long of the Corps of Topographical Engineers to report on the feasibility of building a canal between the Illinois River and Lake Michigan as had been suggested by Joliet. Long reported, "A canal uniting the waters of the Illinois with those of Lake Michigan may be considered the first of importance of any on this quarter of the country, and at the same time, the construction of it would be attended with very little expense compared with the magnitude of the object."[18] Secretary of War John C. Calhoun issued another report in 1819 focusing on developing a road and canal system for military purposes that agreed with Long's assessment. While Congress failed to act on the War Department's recommendation, the newly-formed state of Illinois recognized the necessity for inland waterway construction to help the state's economy and lobbied for its construction. In 1822, the federal government authorized the state to build a canal, providing that the state finalize and map the route within three years and that construction be complete by 1834.[19] The Illinois & Michigan Canal, as it was called, was the first canal to be constructed, setting the stage for an extended period of canal development in this region.

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[14] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, Chapter 2, specifically pp. 20-21; W.C. Weeks, "The Illinois Waterway," *The Military Engineer* 24, no. 135 (May-June 1932): pp. 229-230.
[15] Weeks, p. 231.
[16] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 24-25.
[17] Weeks, p. 231.
[18] "Graham and Phillips Report," in *American State Papers, Miscellaneous*, Volume II, (Washington, DC: Gates and Seaton, 1834), p. 555, quoted in Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 25.
[19] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 26-27.

Illinois & Michigan Canal
In 1825, work began in earnest on the Illinois & Michigan Canal (I&M Canal) with the incorporation of the Illinois & Michigan Canal Company, tasked with funding and building the canal. The company had a $1 million allocation from the state for construction and the authority to raise more via toll collection. There was opposition to the plan to fund the canal via tolls, which hampered the company's ability to sell stock. Consequently the company dissolved a year later. Congress reinvigorated the canal idea by granting land for its route. The land grant came with provisions: the state had to start construction by 1832 and finish it by 1847, and grant the federal government and its representatives free access to the completed canal. The state agreed to the terms and established a Board of Canal Commissioners, who hired engineer James Bucklin and surveyor Samuel Alexander to survey the route.[20]

Despite the longstanding interest in a waterway, though, attention soon shifted to building a railroad instead, and Congress granted permission for the land to be used either for a canal or for a railroad in 1833. The state then abolished the Board of Canal Commissioners only to reinstate it in 1835, the result of the U.S. Army Corps of Engineers embarking on an improvement project at the Chicago Harbor and the election of Gov. Joseph Duncan, a supporter of waterway construction. A year later, the board hired William Gooding to survey the route. Gooding determined the "deep cut" canal would begin at Bridgeport on the South Branch of the Chicago River, travel to Lockport, extend south to Joliet, cross the Des Plaines River, travel southwest following the right bank of the Des Plaines and Illinois rivers, and end at La Salle. The dimensions of the canal were 60' wide at water level and 36' wide at the bottom with a minimum 6' depth. There were to be a total of eighteen locks measuring 18' wide x 110' long, sixteen of which would be lift locks due to extreme changes in elevation. The canal would also require three dams, four aqueducts, two feeder canals (one at the DuPage River near Channahon and one at Fox River near Ottawa), and one lateral canal at Ottawa. Since this was a "deep cut" canal, gravity would allow the water to flow from Lake Michigan into the South Branch of the Chicago River and down the canal.[21]

Construction of the I & M Canal began on July 4, 1836 at Canalport but was piecemeal due to a lack of funds and the Panic of 1837.[22] To cut costs, the Illinois General Assembly adopted a "shallow cut" plan in February 1843 that required construction of two more feeder canals from the Little Calumet River and the Kankakee River. Construction resumed in 1845 and the Illinois & Michigan Canal finally opened on April 20, 1848. The route extended from the left bank of the South Fork of the South Branch of the Chicago River and ran 32 miles to Joliet. After Joliet, it extended another mile to the Des Plaines where it traveled along the right bank of the Des Plaines and Illinois rivers for another 64 miles. The canal ended at La Salle for a total distance of 97 miles. Fifteen masonry locks measuring 18' wide x 110' long with 6' deep miter sills were constructed to accommodate the 146' fall. The total construction cost was $6.6 million, to be paid for by tolls. By the time of its completion, however, the usefulness of the canal was severely hampered by its small size, which prevented navigation by the larger ships plying the

[20] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 27-29.
[21] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 30-31.
[22] Work stopped in 1839 and then again in 1842 after the state went into bankruptcy following the failure of the Illinois State Bank.

Mississippi River, and by the fact that the Illinois River was still not navigable. Despite these limitations, the canal was influential in Chicago's ascendency as an industrial center.[23] (See Appendix B, Figure 1 for map)

Although the I&M Canal's usefulness may have been limited in terms of shipping capacity, the city of Chicago viewed it as beneficial for carrying away the city's sewage. City officials authorized $3 million to be spent on rebuilding the canal from Bridgeport to Lockport so it would follow Gooding's original 1837 deep cut plan. The improved canal reopened in 1871. The work had reversed the flow of the Chicago River so water ran out of Lake Michigan, thereby easing the city's sewage problems for a short while until 1881 when additional dredging was necessary.[24] Realizing the limited usefulness of the I&M Canal, Illinois transferred it to the federal government in 1882 with the condition that the 97 mile-long canal be enlarged and maintained as a commercial waterway.[25]

The I&M Canal was rendered completely obsolete with the 1933 completion of the Illinois Waterway. That year, a Civilian Conservation Corps crew was employed creating a park along the canal's route. In 1947, the State of Illinois received authorization from Congress to use the canal's right-of-way for highway, park and recreational use since the federal government had given up all claim to it. The Illinois & Michigan Canal National Heritage Corridor was established in 1984, the first in the country.[26]

Hennepin Canal

Another early regional waterway was the Hennepin Canal (also known as the Illinois & Mississippi Canal). Civil engineer and surveyor Graham P. Low completed the survey for the canal in 1870. He recommended building it from Great Bend at Hennepin on the Illinois River to Rock Island on the Upper Mississippi. A Senate-appointed committee studied the proposal but did not take any action.[27] The idea of the Hennepin Canal was revisited in 1882-83 in response to increasing pressure to create a canal that could link the I&M Canal with the industries located in such cities as Rock Island, Davenport, Burlington, and Dubuque.

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[23] Weeks, p. 231; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 33-36. The National Register nomination gives the total distance as 101 miles, see Blanche Shroer, Grant Peterson, and Sydney Bradford, "Illinois and Michigan Canal," National Register of Historic Places Nomination Form, 1976.

[24] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 39, 44.

[25] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 44; Roald Tweet, *A History of the Rock Island District Corps of Engineers* (Rock Island, IL: U.S. Army Engineers District, Rock Island, June 1975), p. 66.

[26] Department of Public Works & Buildings, "132 Years of Public Service: The History and Duties of the Division of Waterways," (State of Illinois, 1955), p. 8; for National Heritage Corridor information see, http://www.nps.gov/ilmi/, accessed November 2008. The portion of the canal between Lockport and La Salle was designated a National Historic Landmark in 1964, see http://tps.cr.nps.gov/nhl/detail.cfm?ResourceId=221&ResourceType=Structure, accessed November 2008. HABS/HAER conducted a multi-year survey and prepared an inventory of historic structures within the Illinois & Michigan Canal National Heritage Corridor from 1985-1987.

[27] The dimensions of the Hennepin Canal were to be 160' wide and 7' deep with 70' x 350' locks. See Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 40. Roald Tweet discusses this canal in *A History of the Rock Island District Corps of Engineers*, noting the route generally followed an earlier survey by civil engineer J.O. Hudnutt in 1866, p. 66.

Proponents hoped the Hennepin Canal would be capable of handling heavy and bulky freight that could not be transported via the railroad, thus lowering transportation rates. Maj. William Henry Harrison Benyaurd and H.B. Herr conducted a survey for such a canal following the general route recommended by Low. Benyaurd developed three potential routes, but once again, Congress failed to act. A few years later in 1886, Congress appointed a Board of Engineers to examine Benyaurd's proposed three routes. The board chose a route in the Rock Island area and then submitted it to Congress. In 1888, Capt. William L. Marshall completed the detailed plans based on the chosen route, which ran from the Illinois River above Hennepin to Bureau Creek Valley, Penny Slough and then on Rock River to its mouth at the Mississippi River, a total distance of 188 miles. An allocation of $500,000 was made to purchase the waterway's right of way and build 5 miles near Rock River in the Rivers & Harbors Act of 1890.[28] Construction of the Hennepin Canal took place from 1892-1907.[29] When the canal opened in 1907, however, its usefulness was already limited by its small size and increasing competition from the railroad. By 1946, the deteriorating canal was only open on Thursdays and Fridays to cut operation costs. In 1951, the federal government completely closed it to traffic, and in 1970, the Hennepin Canal was turned over to the State of Illinois for use as a recreation area.[30] (See Appendix B, Figure 1 for map)

Chicago Sanitary & Ship Canal

The increasing population of Chicago in the second half of the nineteenth century resulted in rising amounts of sewage being released into the Chicago River and contaminating not only the river but also Lake Michigan, from which the city drew its drinking water. Installing pumps where the I&M Canal joined the Chicago River and lowering the level of the canal from 1866-71 did little to mitigate the problem. In 1889, the State of Illinois authorized the establishment of the Sanitary District of Chicago to deal with the sewage problem.[31] The Chicago Sanitary District undertook construction of the Chicago Sanitary & Ship Canal in September 1892 for the purpose of diverting water from Lake Michigan to dilute and carry the city's sewage away from the lake. Isham Randolph, Chief Engineer, and his successor in July 1907, G. M. Wisner, Consulting Engineer, oversaw the project.[32] The 28 mile-long route extended from the west fork

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[28] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 41-43; Tweet, p. 66. For detailed information about the waterway's route, see Tweet, pp. 68-71.

[29] The Hennepin Canal held the distinction of being the first U.S. canal built solely of Portland cement. Earlier concrete canals had been faced with cut stone. The concrete mixing machines used in the construction of the canal were also prototypes. The use of cement allowed the lock size to be increased as well as being a cheaper construction material. See Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 43-44; Tweet, p. 68.

[30] Tweet, pp. 71-72.

[31] Weeks, p. 231.

[32] Estimates for the cost of the canal vary widely, from $59,566,000 to $75 million to $80 million. See W.G. Gude, "Illinois Waterway Is Now Completed: Final Link in Lakes to Gulf System," *Marine Review* 63, no. 6 (June 1933): p. 19; "Preliminary Examination and Survey and Review of Reports on Calumet-Sag Channel (1931-33)," p. 4, in Folder 800.921, File #2, in U.S. Army Corps of Engineers, Chicago District, Record Group 77, National Archives and Records Administration, Great Lakes Region-Chicago (hereafter cited as RG 77, NARA, Chicago); U.S. Congress, House of Representatives, "Hearings before the Committee on Rivers and Harbors, House of Representatives, Seventy-Third Congress, Second Session on the Subject of the Improvement of Illinois Waterway (Calumet, Little Calumet River, and Sag Channel Section), Illinois," (Washington, DC: U.S. Government Printing Office, 1934), p. 1.

of the South Branch of the Chicago River, paralleled the I&M Canal, and originally ended at a basin near Lockport where Stoney gates and a bear trap dam controlled the discharge into the Des Plaines River. Pumps were installed at the main channel's intersection with the Chicago River's South Branch to bring water from Lake Michigan into the channel.[33] (See Appendix B, Figure 1, canal labeled as Chicago Drainage Canal)

A 1903 law allowing the generation of power on the canal resulted in a canal extension (designed by Isham Randolph) nearly 2 miles to Lockport, where two movable dams, lock and a power house were constructed.[34] The power house allowed the Sanitary District to earn some additional revenue by selling the electric power generated. As completed, the canal was 20' to 24' deep with bottom widths ranging from 160' to 202', widening at its terminus.[35]

According to W.C. Weeks in a 1932 article, "the construction of the Main Sanitary and Ship Canal connecting two great watersheds is considered one of the outstanding engineering accomplishments in America if not in the whole world. The drainage of densely populated metropolitan areas these canals affect has made possible the phenomenal growth of Chicago and its environs and saved countless human lives."[36] The usefulness of the Chicago Sanitary & Ship Canal as a transportation route was limited since the Des Plaines River was not navigable at that time. Its primary purpose was to ease the sanitation problems of Chicago with the additional benefit of power generation. The real significance of the canal was its position as "one of the first large, multi-purpose waterway projects" in the country, marking the "shift from single-purpose waterway projects to multiple-use waterway development."[37] As the railroad expanded across the country, it became increasingly necessary for waterway projects to have multiple purposes to justify their existence, such as a combination of navigation, flood control, and power generation.[38]

Calumet-Sag Channel (also known as the Cal-Sag)

Ongoing issues with Chicago's sewage led to the construction of yet another canal, the Calumet-Sag Channel, from 1911 to 1922 by the Sanitary District. Connecting the Chicago Sanitary & Ship Canal with the Little Calumet River near Blue Island, the Cal-Sag extended just over 16 miles. The Army Corps initially balked at approval amid concerns that "other towns along Lake Michigan were thinking of using the 'Chicago solution' to their own waste management" but eventually succumbed to pressure. As constructed, the channel eased Chicago's sewage disposal problem by reversing the flow of the Little Calumet River, which originally drained into Lake Michigan, so that it emptied into the Illinois River. To accomplish this, the 20' deep and 36' to

[33] Edward Wegmann, CE, *The Design and Construction of Dams, Including Masonry Earth, Rock-Fill, Timber and Steel Structures, Also the Principal Types of Movable Dams* (New York: John Wiley & Sons, Inc., 1922), pp. 362; Louis P. Cain, "Unfouling the Public's Nest: Chicago's Sanitary Diversion of Lake Michigan Water," *Technology and Culture* 15, no. 4 (October 1974): pp. 594-613; Rathburn, "Architectural and Engineering Resources," Volume I, p. 46.
[34] Wegmann, *The Design and Construction of Dams,* pp. 362-363. See Figure 119 for a section through the dam.
[35] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 53; Weeks, p. 231.
[36] Weeks, p. 233.
[37] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 47.
[38] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 46-49.

60' wide at the bottom channel was outfitted with a regulating lock at Blue Island.[39] (See Appendix B, Figure 2 for map of area and channel)

The Little Calumet River was one of a network of waterways (including the Grand Calumet River, Calumet River and Lake Calumet) that connected the Calumet industrial area south of Chicago with the Illinois Waterway. The Calumet River, located within the corporate limits of Chicago, begins at the junction of the Little Calumet and Grand Calumet rivers and extends 7.7 miles to the Calumet Harbor at Lake Michigan in South Chicago.[40] The Little Calumet River runs 60 miles from Indiana to the Grand Calumet River. The Cal-Sag connects with the Little Calumet River 6.4 miles upstream from its junction with the Grand Calumet. "Local interests" had dredged this 6.4 mile section to a 13' depth and 60' width. The marshy Lake Calumet is located on the southeast edge of Chicago. Measuring 3 miles long and 1-1/2 miles wide, it connected to Turning Basin 5 by a short channel. Advocates saw potential in using the lake as an inland terminal and transfer harbor.[41]

Soon after the completion of the Cal-Sag, local interests began lobbying to improve its route in an effort to create an "efficient and economical modern barge service." The impetus to improve the Calumet area waterways came from the impending completion of the Illinois Waterway and a desire to take advantage of the new navigable route to the Mississippi River. The Cal-Sag at that time did not allow the industries located in such cities as Hammond, East Chicago and Gary direct access to the Illinois Waterway, nor could it accommodate the traffic plying the Illinois Waterway. As described at the time, "the movement of river barges through the open lake is unsafe," so area industries "are required to lighter, switch or truck their goods to and from barge terminals on the Calumet River and Lake Calumet unless the Grand Calumet River is improved."[42]

The River and Harbor Act of July 3, 1930 approved the survey of the Calumet River, Little Calumet River, Lake Calumet and the Sag Channel "with a view to providing a connection with, and terminal transfer harbors for, the waterway from Chicago to the Mississippi River."[43] The proposed improvements were to "widen, straighten and deepen the Grand Calumet River between its confluence with the Little Calumet and its junction with the Indiana Harbor Canal, and later, to extend this improvement to a connection with the Gary Harbor." Since the proposed

[39] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 64-65; Weeks, p. 231; "Preliminary Examination and Survey," p. 2; National Rivers and Harbors Congress, Projects Committee, February 1940, Application made to Fred D. Beneke, Secretary, National Rivers and Harbors Congress, Washington, DC for examination and recommendations by Projects Committee for Calumet-Sag Channel, Illinois and Indiana Harbor and Canal, Indiana, in Folder 800.921, File #5, in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago; Gude, p. 20.
[40] The Calumet River was dredged to a 21' depth with a 200' wide channel from its mouth to Turning Basin 5. "Local interests" had dredged it to a 13' depth and 90' width. See "Preliminary Examination and Survey," p. 2.
[41] "Preliminary Examination and Survey," p. 2.
[42] Lighters are barges used to unload and load ships. "Preliminary Examination and Survey," p. 4; "Proposed Improvement of the Grand Calumet River in Illinois & Indiana," Memorandum by Chicago Regional Planning Association, Burnham Building, Chicago, September 1930 in Preliminary Examination-Cal-Sag Channel, Calumet River, Little Calumet River, and Lake Calumet, 1930-31, Folder 800-921, File #1, in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.
[43] "Preliminary Examination and Survey," p. 1.

improvement of the Grand Calumet River between the Indiana Harbor Canal and the Calumet-Sag Channel spanned two districts, the board in charge of the work included members of both: Col. E. H. Markham, Division Engineer of Cleveland; Col. George Spalding, Division Engineer of St. Louis; Col. W. C. Weeks, the U.S. District Engineer from the First Chicago District; and Major H.J. Wild, the U.S. District Engineer from the Second Chicago District.[44]

In 1940, attention again turned to improving the Calumet-Sag Channel.

> This improvement is part of the larger plan improving the Illinois Waterway from its junction with the Mississippi at Grafton to Lake Michigan. It will make the Calumet-Sag Channel route the main link between Lake Michigan and the Des Plaines River valley, instead of the Chicago Sanitary and Ship Canal—Chicago Route which traverses the congested portions of the city. It will stimulate water commerce by providing a satisfactory outlet to the lake from the Illinois waterway and the large network of inland waterways connected with it. It is of especially great value because it will serve the most concentrated industrial district in the middle-west, at the southern tip of Lake Michigan near Calumet and Indiana harbors, where are located numerous steel mills, oil refineries, and storage plants, grain elevators, chemical plants, and other heavy industries.[45]

The work involved enlarging the channel from its junction with the Little Calumet River to its junction with the Chicago Sanitary & Ship Canal to 9' deep and 160' wide; building locks at sites chosen by the Army Corps "to prevent reversals of flow, to maintain the water levels west of the locks at two feet below Chicago city datum, and to regulate diversion"; dredging a barge canal 9' deep and 160' wide in the Grand Calumet River from its junction with the Little Calumet River to its junction with the Indiana Harbor Canal; and rebuilding or altering a number of highway bridges at various locations. The Little Calumet River was dredged from its junction with the Calumet-Sag Channel to its junction with the Grand Calumet River to a 9' depth and 300' width. From the junction of the Little Calumet and Grand Calumet rivers to Turning Basin 5 (a distance of 1.61 miles), a 300' wide and 9' deep channel had been created. From Turning Basin 5 to Calumet Harbor, the river was 21' deep and 200' wide. Lake Calumet, which connected to the Calumet River at Turning Basin 5 by a channel, had also been improved. The connecting channel had been dredged to a 21' depth, and a terminal basin measuring 3,200' long and 670' wide had been built.[46]

In 1946, Congress authorized the removal of the Blue Island Lock and the construction of a new lock and control works on the Calumet River.[47] Blue Island Lock and Control Works were finally removed from operation in 1965, replaced by the new Thomas J. O'Brien Lock and Control Works (built from 1957-60) at the head of the Calumet River.

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[44] "Proposed Improvement of the Grand Calumet River," p. 2.
[45] Application made to Fred D. Beneke.
[46] Application made to Fred D. Beneke.
[47] The work was authorized in H Doc. 677, 79th Cong., 2d session, July 24, 1946, reported in U.S. Army Corps of Engineers, *Annual Report of the Chief of Engineers, U.S. Army*, (Washington, DC: Government Printing Office, 1957), p. 1267 (hereafter cited as USACE, *Annual Report*, date of publication).

Within this network of various regional waterways, which included the Illinois & Michigan Canal, Hennepin Canal, Chicago Sanitary & Ship Canal, and the Calumet-Sag Channel, the Illinois Waterway was planned and built to serve as the primary navigable inland waterway route from Chicago to the Mississippi River.

THE ILLINOIS WATERWAY

Planning

Despite the completion by 1848 of the Illinois & Michigan Canal, improvements were still needed to make large portions of the Illinois River navigable and maintain the 7' depth then deemed adequate for waterway traffic. Various surveys were done of the region and piecemeal improvements made throughout the second half of the nineteenth century in advance of the development and construction of the Illinois Waterway. The 1866 Rivers and Harbors Act authorized a survey of the Illinois River as part of a larger initiative to review waterway projects. Gen. James H. Wilson and civil engineer S.T. Abert determined that the Des Plaines and Illinois rivers from Lockport to Grafton should be improved by a slack water navigation system. Wilson and Abert also recommended creating a 7' deep channel on the Illinois & Michigan Canal by dredging and constructing 75' x 350' locks in an effort to make it accessible to Mississippi River traffic. Congress authorized undertaking additional survey work on the Illinois and Des Plaines rivers in 1867. New plans by General Wilson and civil engineer William Gooding called for a slack water navigation system running from Grafton to Joliet with a separate canal bypassing the rapids at Marseilles.[48] In 1883, George Y. Wisner, U.S. Assistant Engineer, surveyed the Des Plaines River from La Salle to Joliet and recommended a 7' deep channel estimated to cost over $3 million.[49]

Construction on the Illinois River during this period included dredging the river to a 7' depth between Henry (located 27 miles below La Salle) and Copperas Creek (located 86 miles below La Salle), funded by an 1869 Congressional appropriation. From 1870-1903, the state and the Corps of Engineers addressed the issue of navigability on the Illinois River with the construction of Henry Lock and Dam, Copperas Creek Lock, La Grange Lock and Dam, and Kampsville Lock and Dam, which created a 7' channel to the Mississippi River.[50]

Citizens groups, business and manufacturing interests, and politicians responding to their constituencies helped maintain a sustained interest in a waterway. The Citizens Association of

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[48] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume 1, pp. 37-38.
[49] The report was in H.D. 134, 48th Cong., 1st sess. Barnes, "The Illinois Waterway," p. 172.
[50] The Illinois State Board of Canal Commissioners received authorization from the Illinois General Assembly to build Henry Lock and Dam (1871-72). The Army Corps of Engineers constructed the Copperas Creek Lock foundation from 1873-74, when the state took over its construction and completed it in 1877 for $347,747.51. Capt. Garrett J. Lydecker of the Army Corps authorized the construction of locks and dams at La Grange and Kampsville in 1877. La Grange was completed in 1899 and Kampsville in 1903, and both measured 75' x 350'. Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 38-43; "The Illinois Sate Waterway for Barge Navigation," *Engineering News-Record*, 85, no. 23 (December 2, 1920): p. 1095; Weeks, p. 231; and Barnes, "The Illinois Waterway," p. 172.

Chicago, for example, lobbied for the improvement of the Illinois and Des Plaines rivers to allow "free passage of the largest Mississippi River steamers and for the passage of suitable naval vessels for defense in times of war."[51] The Lakes-to-Gulf Deep Waterway Association held six annual conventions in the early twentieth century to drum up support for an extensive inland waterway project known as the Lakes-to-Gulf project, which would create a route on the Illinois and Mississippi rivers that the Illinois Waterway would later follow. As envisioned by its proponents, the project would utilize five existing channels: the Chicago River, the Chicago Sanitary & Ship Canal, the Des Plaines River, the Illinois River, and the Mississippi River. The Lakes-to-Gulf route would start at Lake Michigan at the mouth of the Chicago River, follow the Chicago River 6.25 miles to Robey Street, then join the Chicago Sanitary & Ship Canal for 32.35 miles to its junction with the Des Plaines River and the Illinois & Michigan Canal at Joliet. The route would next follow the Des Plaines River channel for 15.73 miles to its junction with the Kankakee, where the Illinois River is formed. The waterway would then travel down the Illinois River 273 miles to its mouth at the Mississippi River and finally the 1,322 miles down the Mississippi to the Gulf of Mexico. Opinions varied as to the depth of the proposed waterway, which was planned for 14' with others advocating 20' to 30' to allow ocean vessels to make their way to Chicago.[52] The proposed Lakes-to-Gulf route would eventually incorporate not only the Illinois Waterway, but also other federal channel improvements, including the 9' Upper Mississippi River project.[53]

The federal government responded to the interest in an inland waterway connecting the Mississippi with the Great Lakes by authorizing even more surveys at the turn of the twentieth century. An amendment to the 1888 Rivers and Harbors Bill authorized the Secretary of War to survey, plan and estimate the cost of creating a channel complete with locks and dams on the Illinois and Des Plaines rivers between Lake Michigan and La Salle "by such route as shall upon examination and survey be decided most practicable."[54] Originally, this "navigable waterway" was to be 14' deep and 160' wide, which was considered adequate for the passage of vessels drawing 14' of water. Capt. W.L. Marshall of the Corps of Engineers reported back to Congress that an 8' channel would be adequate. The 8' depth would also result in cost savings since its construction would be significantly less expensive at $26,888,153 as compared to the 14' channel estimated at $48,282,763. He recommended the waterway start at the Chicago Harbor, run south via Lake Michigan to the mouth of the Calumet River, then to Lake Calumet, and then on a new canal on the Calumet/Blue Island channel to the Illinois & Michigan Canal, which

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[51] "National Capital Miscellany," *Chicago Daily Tribune*, February 17, 1888, p. 6.
[52] William A. Shelton, "The Lakes-to-the-Gulf Deep Waterway I," *The Journal of Political Economy* 20, no. 6 (June 1912): pp. 542-543, 546.
[53] See HAER's documentation of the Upper Mississippi River 9-Foot Channel project, including HAER No. IA-22, Lock & Dam No. 10; HAER No. IL-31, Lock & Dam 26; HAER No. IL-32, Lock & Dam 26R; HAER NO. IL-33, Lock & Dam 27; HAER No. MN-20, Project History; HAER No. MN-21, Lock & Dam No. 3; HAER No. MN-22, Lock & Dam No. 5; HAER No. MN-23, Lock & Dam No. 5A; HAER No. MN-24, Lock & Dam No. 7; HAER No. MO-34, Lock & Dam Complex No. 20; HAER No. MO-35, Lock & Dam Complex No. 22; HAER No. MO-36, Lock & Dam No. 24; HAER No. MO-37, Lock & Dam No. 25; HAER No. MO-50, Lock & Dam Nos. 24-27; HAER No. WI-47, Lock & Dam No. 4; HAER No. WI-48, Lock & Dam No. 6; HAER No. WI-49, Lock & Dam No. 8; HAER No. WI-50, Lock & Dam No. 9.
[54] "An Illinois Waterway, Senator Cullom's Amendment to the River and Harbor Bill," *Chicago Daily Tribune*, May 10, 1888, p. 8.

would be enlarged.[55]

Congress authorized the Army Corps to survey three inland waterway options in 1902, seemingly disregarding the recommendations made by Marshall. The first option was a 14' channel from Lockport to St. Louis via the Des Plaines, Illinois and Mississippi rivers. The second was a 7' channel from Joliet to La Salle on the Illinois River. The third was an 8' channel using the same route as the second option. The Corps recommended the 14' channel option in 1905. From Lockport (where a lock was already under construction at the terminus of the Chicago Sanitary & Ship Canal) to Utica, the Army Corps recommended building a slack water navigation system featuring nine locks (80' x 600' with 14' depth) and five movable Chanoine wicket dams. Existing locks at Henry, Copperas Creek, Kampsville and La Grange would be removed.[56]

In 1908, Illinois voters, fed up with the numerous plans but no Federal action, approved a referendum authorizing the state to spend $20 million on construction of a waterway between Lockport and La Salle. Proponents of the waterway believed that its construction would open the Great Lakes region to the Gulf and beyond, thereby increasing economic and trade opportunities. Proposals for the waterway's route were developed and considered from 1908-12. Plans generally fell into one of two categories: a shallow waterway with small locks to accommodate packets and small tows, or a deeper waterway with larger locks for lake and small ocean steamships. Illinois Governor Charles S. Deneen, Sanitary District Chief Engineer Isham Randolph, and Illinois State Senator Frank P. Schmitt proposed a 14' waterway with hydroelectric power sites at various points. Optimistic that substantial revenues could be generated, the state argued revenues from the sale of power could be used to retire the bonds. In a competing plan, Republican Congressman William Lorimer, waterway engineer Lyman Edgar Cooley, and Illinois House members Thomas H. Riley and Edward J. Smejkal proposed construction of a 24' canal to allow commercial vessels to travel between the Great Lakes and the Gulf of Mexico.[57]

The so-called Deneen plan (in honor of the Illinois governor) eventually submitted to the War Department called for expanding the Illinois & Michigan Canal from Joliet to Dresden Island to a bottom width of 36' and a depth of 8'. It was expected that at some point the canal would be deepened to 14' or even 24'. Locks would generally be 55' wide x 300' long with the exception of one 45' wide x 250' long lock. The waterway would then follow the Illinois River from Dresden Island to Starved Rock, a route that would require construction of a 2-1/2 mile long canal to circumvent the Marseilles rapids. The total price of the waterway was set at $5 million with plans to charge tolls and generate and sell power to offset the construction costs. The War

[55] Illinois State Waterway," 1095; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 45. The report was included HD 164, 51st Cong, 1st sess., see Barnes, "The Illinois Waterway," p. 172.
[56] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 50.
[57] Barnes, "The Illinois Waterway," p. 173; Rathburn, "Architectural and Engineering Features of the Illinois Waterway," Volume I, p. 69; Isham Randolph, "Illinois Ignores Her Waterways," *Chicago Daily Tribune*, December 31, 1911, p. L7; U.S. Army Corps of Engineers, "The Illinois Waterway," p. 39. Rathburn argues that the Deneen plan, with its emphasis on both navigation and power generation was typical of Progressive Era projects, Volume I, p. 69.

Department deemed the locks too small and approval (and thus construction) was once again stalled. No construction permit would be issued by the Corps unless directed to by Congress, which had refused to become involved in a standoff between a state and a federal agency.[58]

Frustrated by inaction, the state legislature authorized $5 million to build an 8' waterway with 45' x 250' locks in 1915 even though a permit had not been issued.[59] The bill authorizing the construction stated:

> For an Act to provide for the construction of a deep waterway or canal to be known as the Illinois Waterway, from the water plant of the Sanitary District of Chicago, at or near Lockport, in Will County, Illinois, to a point in the Illinois River at or near Utica, in La Salle County, Illinois, to provide for the issuance of bonds to pay for said deep waterway, to provide for the development and utilization of the water power that may be generated from the water flowing through said waterway, to create a commission known as the Illinois Waterway Commission, and to make an appropriation to carry out the provisions of this Act.[60]

The state's 1915 plans were submitted to the War Department for approval and issuance of a permit. The route would begin at Chicago and extend along the Chicago Sanitary & Ship Canal's channel to Lockport, where the existing lock would be enlarged or a larger one constructed in order to have a 55' x 300' lock with 14' depth over miter sills at that location. The Sanitary District's 2 mile-long tail race extending from the lock to the upper basin at Joliet would be used nearly as it already existed. At the junction of the tail race with a dam at Jackson Street in Joliet, the "basin shall be improved by the removal of existing sediment and obstructions so that a channel of not less than eight (8) feet in depth and two hundred (200) feet in width shall be obtained." The lock at the entrance to the Illinois & Michigan Canal would be rebuilt or a new one built (referred to as Lock A with dimensions of at least 45' x 250').

The waterway's route would then follow the existing Illinois & Michigan Canal a total distance of 17 miles with a minimum 36' bottom width and 60' surface width. Lock B with a 12' lift was to be constructed "immediately north of Du Page River" and would measure 45' x 250'. The waterway between locks B and C would use the 1,500' of the Illinois & Michigan Canal crossing the Du Page River. Lock C was to be constructed near Lock 7 of the Illinois & Michigan Canal. This lock would have a 4-1/2' lift and like the other proposed locks would be 45' x 250'. The waterway would continue using the I&M Canal's channel for the 6 miles between locks C and D. Lock D, located at the upper end of Dresden Island and measuring 45' x 250', would connect the Illinois & Michigan Canal with the Illinois River.

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[58] U.S. Army Corps of Engineers, "The Illinois Waterway," pp. 39-40; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 69; Staff Correspondent, "Federal Experts Back Up Deneen on Deep Waterways," *Chicago Daily Tribune*, February 21, 1914, p. 13. Rathburn gives the lock measurements as 55' x 200', see Volume I, p. 69.

[59] "Illinois State Waterway," p. 1095.

[60] In House Bill No. 914 in Senate, 49th General Assembly, 1915, text located in Folder 285/68b, File #1, in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.

Extending 24 miles from Dresden Island, the waterway would follow the Illinois River to a point near Ballards Island. Dredging would be done if necessary to maintain an 8' depth and a 150' surface width. At Marseilles, a lateral canal measuring 100' to 150' wide and 8' deep would be built to bypass the rapids in this area. At the end of this section, Lock E (measuring at least 55' x 300') would be constructed. The waterway would then once again follow the Illinois River channel for 16 miles to a point near Starved Rock where Lock F (measuring at least 80' x 600') would be built. Above Starved Rock on the Illinois River, "there shall be constructed a permanent and substantial dam of concrete of the most modern design and type, at least equal to or better than the design and type of the dam across the Mississippi River at or near the city of Keokuk, Iowa, sufficient to control the water in the pool created by said dam to an elevation of one and one-half (1 ½) feet above previous maximum high water at the highway bridge across the Illinois River at Ottawa." Water power could be developed at this site by the state if desired. Below the dam, the channel would have an 8' depth and 150' width to a point near Utica, where a 1 mile channel would excavated.[61]

The Army Corps balked at approving the plans, with the Chief of Engineers denying the permit for a number of reasons, both technical and legal. Judge Advocate General Crowley outlined the issues in a September 1915 memo. The Chief of Engineers had denied the permit for construction because of the "technical inconsistency of the project" that he feared would require the federal government (if asked to assume authority over the waterway) to "make large expenditures for additional improvements which cannot now be estimated." He also perceived the state's interest in the Illinois Waterway as resulting in the "partial abandonment" of its obligation to maintain the deteriorating Illinois & Michigan Canal. He thought it would be more prudent of the federal government to construct the waterway itself. Furthermore, the Chief of Engineers did not believe he even had the authority to recommend the work, noting that Congress alone could "appropriate public navigable waters." The issue of generating hydropower on the waterway and the potential of the state to retain power over generating facilities even if the waterway itself was turned over to the federal government was another sticking point, since the "settled policy" of the federal government was to use such funds to defray improvement costs. Finally, the Chief of Engineers was concerned about increasing water diversion from Lake Michigan. After detailing the Chief of Engineers' concerns, Judge Advocate Crowley advised that he had no legal objections to the project. Despite Crowley's findings, the Army Corps still denied the permit.[62]

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[61] Appendix IV, "Descriptive Details, Original Plan, Illinois State Waterway," submitted to War Department, 1915, in Army Corps, "Illinois Waterway," p. 81; House Bill No. 914 in Senate, 99th GA, 1915 reported from House, May 25, 1915, pp. 2, 5-11, in Folder 285/68b, U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.
[62] Judge Advocate General Crowley, War Department, Office of the Judge—Advocate General, Washington, to Secretary of War "for his personal consideration," Subject: Application by Governor of Illinois on behalf of state for approval of plans to improve section of Illinois and Des Plaines Rivers between Lockport and Utica, September 24, 1915, pp. 3-6 in U.S. Army Corps of Engineers, Rock Island District, Organization and Organization Charts of Six Foot Channel Project 1921, RG 77, NARA, Chicago.

The state applied for a rehearing on the proposed waterway in 1916.[63] Governor Dunne argued to Secretary of War Newton D. Baker that "bureaucratic arbitrariness" had resulted in the permit denial. The *Chicago Daily Tribune* expressed outrage over the delays, stating the project was of national importance with benefits that would extend far beyond just the state of Illinois:

> It is one of the ironies of politics that a government which spends hundreds of millions of federal funds on waterway projects, many of them worthless, finds it difficult to grant a technical permission to the state of Illinois to create a practical waterway without expense to the federal government.
>
> If there is any legitimate waterway project in the United States it is this enterprise which the people of Illinois have conceived and are willing themselves to pay for. If there is anything in inland waterways, there should be in this, which passes through a rich territory and connects the second city of the United States with the Mississippi and the Gulf of Mexico.[64]

Illinois Governor Frank Lowden continued to support the delayed waterway. In 1917, he established the Division of Waterways under the Illinois Department of Public Works and Buildings with Mortimer Grant Barnes as Chief Engineer.[65] Lowden and Barnes advocated constructing an 8' canal with the option of excavating it to 14'. Locks were to be 110' x 600'. The waterway would be multi-functional, serving both as a navigation route and a power generator.[66] The Acting Secretary of War was unimpressed with the potential of such a waterway, a view not shared by Gen. William M. Black, Chief of Engineers, who reportedly stated: "The utilization of this stream, therefore, from Chicago with direct water connection on the north as far as St. Paul and Minneapolis on the west to Kansas City, and south and east to Pittsburgh and New Orleans, will link together by an all water route many of the principal freight tonnage producing cities of the United States. Its importance can hardly be overstated."[67]

By 1919, movement had finally begun on approving and starting construction of the waterway. The legislature passed the 1919 Illinois Waterway Act, which authorized the state to begin construction and issued a $20 million bond for financing, allowed portions of the I&M Canal to be used, and permitted the state to generate and sell power produced by power plants located at the lock and dam sites. The sale of power would be used to offset construction costs. (The

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[63] "Dunne Demands Rehearing of Waterway Case," *Chicago Daily Tribune*, March 1, 1916, p. 20; "The Illinois Waterway Petition," *Chicago Daily Tribune*, April 12, 1916, p. 8.
[64] "The Illinois Waterway," *Chicago Daily Tribune*, May 4, 1916, p. 6.
[65] The Division of Waterways incorporated the Canal Commissioners (initially created in February 1823 by the state legislature with oversight over the I&M Canal), as well as the Rivers & Lakes Commission (established in 1911 to oversee the state's public waters) and the Illinois Waterway Commission (established in 1915 to issue and sell bonds to pay for the waterway as well as supervise the construction, operation and maintenance of the waterway and develop water power at the sites). Department of Public Works & Buildings, "132 Years of Public Service: The History and Duties of the Division of Waterways," (State of Illinois, 1955), pp. 5, 7; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 70.
[66] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 70.
[67] Staff Correspondent, "Waterway Once More Becomes Important Topic," *Chicago Daily Tribune*, December 16, 1918, p. 18.

exception was at Lockport where a hydropower plant was already in operation.) The city of Joliet also approved its construction, which was necessary since the proposed waterway would cut directly through the city. The act detailed the waterway's specification: 8' deep channel in sections with a dirt bottom and 10' deep in those with a rock bottom, a bottom width of 150', and Ohio River Standard locks measuring 110' x 600' with 14' depth over miter sills. The Army Corps had established the standard on the Ohio River (hence the name) at "the Davis Island Lock and Dam in 1878 as the standard 'gauge' for American waterways."[68]

With the final route set, running from "the water power plant of the sanitary district of Chicago at Lockport, twenty miles south of Chicago and extending through the tail race of the sanitary canal to its junction with the Des Plaines river...follows the latter stream, and also the Illinois-Michigan canal, through the city of Joliet to the Illinois River and thence along that body of water to Utica," the plans were submitted to the federal government. The Secretary of War and the Chief of Engineers finally gave the project their approval, and the Army Corps of Engineers issued the state a work permit on March 6, 1920.[69] (See Appendix B, Figure 3 for map)

A half century of planning had at last culminated in the state beginning construction of an inland waterway linking the Great Lakes with the Mississippi River and beyond. The high expectations held for the project can be seen in the *New York Times*, which reported in the fall of 1920:

> The State of Illinois recently appropriated $20,000,000 to put through the Illinois Waterway. This project will be a key that will unlock the vast treasure house of the Mississippi Valley to the ports of all the world, not to mention the creation of a marvelously cheap means of transportation within the valley itself, according to its advocates. Economically, the claim is that the creation of this strip of navigable water, sixty-five miles long and eight feet deep, to link Chicago and the Great Lakes with the Mississippi River, its tributaries, the Gulf, the Panama Canal, the Golden Gate, Europe and all the world, will create avenues of transportation, so cheap and quick that commerce will inevitably and automatically use it to the limit. And the further argument is that it makes it possible to ship freight from the Mississippi Valley to the Pacific Coast through the Panama Canal instead of by rail, and will thus allow the Middle West to compete with the Atlantic Coast cities in that market.[70]

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[68] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 70, 73; "Push the Waterway," *Chicago Daily Tribune*, April 7, 1919, p. 8; E.O. Phillips, "Waterway Wins House Victory; Dirt to Fly Soon," *Chicago Daily Tribune*, June 4, 1919, p. 21; E.O. Phillips, "Go Home Satisfied it was a Good Job," *Chicago Daily Tribune*, June 22, 1919, p. 8; Barnes, "The Illinois Waterway," p. 76.

[69] Army Corps of Engineers, "The Illinois Waterway," p. 40; "Illinois State Waterway," p. 1095; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 70; "Illinois Starts $20,000,000 Waterway Soon," *Chicago Daily Tribune*, October 16, 1921, p. 14. Other sources say the permit was received in January with work expected to begin in July, see "Illinois Waterway Certain, Will Cost $20,000,000 and Give Chicago Boat Connection with Gulf," *Washington Post*, January 17, 1920, p. 6; "State Waterway to be Started July 1," *The Chicago Defender (Big Weekend Edition)*, January 31, 1920, p. 11.

[70] Wainwright Evans, "Chicago's Panama Canal," *New York Times*, September 12, 1920, p. X4.

Optimistic projections were made about the volume of traffic on the waterway, with Chief Engineer Barnes estimating 10 million tons a year. First, though, the state had to complete a massive construction project.

Building

In the midst of great excitement, the state finally began construction on the long-awaited waterway in 1920 at Marseilles, with the governor promising the waterway's completion by 1925 (a promise that would prove impossible to keep). The initial project supervisors were Col. C. R. Miller, Director, Department of Public Works and Buildings; W.L. Hackett, Superintendent, Division of Waterways; and M.G. Barnes, Chief Engineer, Illinois Waterways Division.[71] The project received a boost in support from then Secretary of Commerce Herbert Hoover in 1926 when he began advocating a comprehensive inland system to include the Lakes-to-Gulf waterway, St. Lawrence Seaway, an east-west trunk waterway from Pittsburgh to Kansas City, and a waterway on the Upper Mississippi from Minneapolis/St. Paul to the mouth of the Illinois River.[72] Hoover reportedly "recognized the need for a more coordinated and sensible development of the water systems of the United States," and consequently, "developed a finished theory of what should be done in order to make proper progress." He thought the country's "drainage systems" had four functions: power generation, irrigation, transportation and sanitation.[73]

A number of issues disrupted the construction of the waterway throughout the 1920s. One issue was land condemnation proceedings. In 1923, a legal dispute arose centering on the authority of the state to condemn land for the waterway. The dispute had been precipitated by condemnation proceedings underway at Utica near Starved Rock. The La Salle County Court issued a stop work order, ruling that the state could not condemn land for the waterway project without submitting plans to all cities and villages along the route and receiving approval from all authorities.[74] The case continued to cause delays in construction into 1925 when the Illinois Supreme Court upheld the decision of the county court.[75]

A second issue arose with the 1930 ruling by the Supreme Court limiting the amount of water diverted from Lake Michigan. The flow at Lockport was set at 6,500 cubic feet per second (cfs). After December 1935, it was to be reduced again to 6,000 cfs, and three years from that date to 1,500 cfs. The limitation was less than the 5,000 cfs of water initially deemed necessary by the War Department to accommodate barge traffic and keep the Chicago River "sanitary."[76] Illinois

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[71] M.G. Barnes, "Lakes-to-Gulf Route to Boom Nation's Trade," *Christian Science Monitor*, December 2, 1924, p. 13. In 1925, the state legislature created the Department of Purchases and Construction and assigned it the task of designing and constructing the waterway. Once the project was complete, the department would be abolished. Department of Public Works & Buildings, "132 Years of Public Service," p. 7.

[72] Arthur Sears Henning, "Chicago Is Hub of Vast Hoover Waterway Plan," *Chicago Daily Tribune*, January 18, 1929, p. 1.

[73] "Water and the National Future," *Engineering News-Record* 97, no. 10 (September 2, 1926): pp. 364-65.

[74] "Waterway Hit Hard by Ruling of County Judge," *Chicago Daily Tribune*, April 7, 1923, p. 6.

[75] "Waterway Hits Snag in State Supreme Court," *Chicago Daily Tribune*, February 18, 1925, p. 12.

[76] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 83; "Hoover Orders Survey to Fix Lake Diversion," *Chicago Daily Tribune*, May 5, 1929, p. 26; Arthur Evans, "Hughes' Report Found to Clear Gulfway Path," *Chicago Daily Tribune*, December 19, 1929, p. 12.

legislators argued the reduction in diverted water would threaten the viability of the waterway by not allowing a 9' depth to be maintained. In addition, a reduction in flow would jeopardize power generation and associated revenues that the state had hoped would help retire the $20 million bond.[77] A 1930 report by Maj. Gen. Lytle Brown, Chief of Engineers, found navigation could occur on the waterway even with diversion as low as 1,000 cfs. Canalization would be necessary, however, as well as construction of control works on the lower Illinois River since the waterway had been designed to be an 8' channel with a flow of no less than 4,167 cfs.[78]

The biggest problem facing the state turned out to be the lack of construction funds. Rep. Edward E. Denison planned to ask for an additional $3 million to be added to the Rivers and Harbors Bill for the waterway's construction in 1928.[79] That same year, Rep. W.E. Hull identified another potential funding source, pointing out that monies already appropriated to the state in the Rivers and Harbors bill for harbor improvements could be diverted to the waterway. If no money was made available, officials warned, completion of the waterway could be delayed three to five years.[80] As part of his comprehensive inland waterway plan, Hoover had ordered the War Department to open the Illinois Waterway by 1931. Completion of the waterway had been projected for April 1, 1931 in keeping with Hoover's order, but the state needed approximately $4 million to finish by that date. Despite the financial crisis, work finally began at the last lock and dam site at Dresden Island in 1929. Progress during the year included finishing Lockport Lock and Marseilles Lock (although the dam at the diversion canal had not been finished). Brandon Road Lock and Dam, meanwhile, was a quarter complete, and Starved Rock Lock and Dam was estimated at 85 percent completion.[81]

With the plans for finishing the waterway in jeopardy, the state and federal government brokered a deal in 1929 in which the government would finance and complete the waterway construction while the state would replace the bridges over the waterway whose clearance would interfere with waterway traffic. At Joliet, for example, a number of bridges did not have adequate clearance for the large vessels it was hoped would ply the waterway. The state first balked at this stipulation, arguing that bridge construction was part of waterway construction.[82] Further controversy occurred over the necessary bridge clearance. The state planned for bridges to have 10' vertical clearance while the War Department specified 16'.[83]

An agreement was finally reached in 1930 when Congress authorized federal oversight of the project on July 3. The federal government then had oversight of the Lockport-Utica section of the Illinois Waterway under construction by the state and the Sanitary District's canals. For the first time, the disparate sections were under one authority—the Army Corps of Engineers' newly created Upper Mississippi Valley Division (UMVD), First Chicago District—creating a unified

[77] Arthur Sears Henning, "Open Fight for Lake Diversion Enabling Laws," *Chicago Daily Tribune*, January 16, 1929, p. 6.
[78] Arthur Crawford, "Army Engineer Opposes Lake Diversion Limit," *Chicago Daily Tribune*, May 16, 1930, p. 8.
[79] "Federal Aid for the Illinois Waterway," *Chicago Daily Tribune*, December 4, 1928, p. 12.
[80] "Jadwin Steps in to Save Illinois Waterway Plan," *Chicago Daily Tribune*, December 4, 1928, p. 26.
[81] "Work Ordered on Waterway," *Los Angeles Times*, May 10, 1929, p. 2; Arthur Evans, "Midwest Starts Drive to Finish Waterway Job," *Chicago Daily Tribune*, January 19, 1929, p. 4.
[82] "Governor Still Hopes U.S. Will Build Waterway," *Chicago Daily Tribune*, May 14, 1929, p. 20.
[83] "New Joliet Bridge Too Low; Holds Up Waterway to Gulf," *Chicago Daily Tribune*, May 14, 1929, p. 20.

authority overseeing the waterway from Lake Michigan to the Mississippi River.[84]

At the time of the transfer from the state to the federal government in 1930, the locks and dams at Lockport and Starved Rock were 95 percent complete, Brandon Road was 70 percent, and Dresden Island was 20 percent. The canal at Marseilles was 65 percent complete while the dam had not yet been started.[85] The House Committee on Rivers and Harbors approved a $7.5 million appropriation to finish the waterway, although the funds would not be available until after July 1, 1931. The justification for the appropriation was that it would provide desperately needed employment opportunities. Furthermore, the Panama Canal had negatively impacted Midwest industry as it provided a much cheaper shipping route for East Coast farmers and businesses shipping goods to the West Coast than Midwest farmers and businesses could obtain. Another justification was that the Illinois Waterway would help provide access to Latin America and more markets.[86] In order to resume work, a plan was devised in which the state of Illinois would lend the $3 million it had in hand to build the bridges over the waterway to the federal government and complete an audit to see if additional funds could be uncovered for construction.[87]

By 1931, the waterway was expected to be finished in time for the 1933 World Fair, although Army engineers optimistically predicted an October 1932 completion date. Starved Rock and Lockport were the most complete at 97 percent each. The pool between Starved Rock and Marseilles was 84 percent finished. Brandon Road Lock and Dam was also well on the way to being complete at 72 percent. Construction of the Marseilles dam had not even started. The pool between Marseilles and Dresden Island was only 42 percent complete while Dresden Island Lock and Dam was 35 percent complete. The pool between Dresden Island and Brandon Road was 30 percent complete.[88]

Lt. Col. Dan I. Sultan, the U.S. District Engineer in charge of construction, reported that a thousand men were at work on the waterway in October 1932. The lock and dam at Starved

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[84] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 83-84. The Corps underwent a reorganization in October 1929, creating the Upper Mississippi Valley Division to supervise the St. Louis, Rock Island, and St. Paul districts, in addition to the newly created First Chicago District.

[85] There is some confusion about the status of construction at Marseilles. Rathburn states that at the time of the transfer of authority, only the canal had been completed and lock construction had just begun (see Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 84-85). In the "The Illinois Waterway" published by the Army Corps in 1930, the Marseilles Lock is noted as being nearly complete, the canal as 65 percent complete and the dam as not yet started (see pp. 50-51). Finally, a March 8, 1931 article in the *Chicago Daily Tribune* notes that Marseilles Lock was only 37 percent while the dam had not been started ("Status of Waterway Project," p. 17). The call for bids for construction of Marseilles Lock was let in 1920, so it seems plausible that the lock would be nearly finished by the time of the 1930 transfer of authority (see Legal Notices, *Chicago Daily Tribune*, September 23, 1920, p. 28).

[86] "Lack of Funds for Illinois Canal Until July, 1931," *Chicago Daily Tribune*, June 27, 1930, p. 17; "The Waterway Approved," *Chicago Daily Tribune*, April 7, 1930, p. 14; Arthur Evans, "Governor to Ask Advice on Loan to U.S. by State," *Chicago Daily Tribune*, July 10, 1930, p. 6.

[87] "Illinois Is Urged to Resume Work on Waterway," *Chicago Daily Tribune*, August 4, 1930, p. 9; "Lakes to Gulf Illinois Link Given Priority," *Chicago Daily Tribune*, August 26, 1930, p. 7.

[88] "Status of Waterway Project," *Chicago Daily Tribune*, March 8, 1931, p. 17; "Illinois Waterway Nears Completion," *Washington Post*, April 3, 1932, p. 5.

Rock had been finished so traffic could go through the Starved Rock pool to the lock and dam at Marseilles, whose construction had been delayed due to labor problems but was slated for completion by October 15. The channel to Dresden Island was expected to soon be completed as was Dresden Island Lock and Dam. Brandon Road Lock and Dam had been finished. The bridges in Joliet would have to be completed, though, before Brandon Road pool could be opened for navigation.[89] By January 1933, three of the four pools had been flooded, the exception being Dresden Island, which was awaiting replacement of a low bridge over the waterway.[90]

In March 1933, the Army Corps opened the Illinois Waterway, which had cost a total of $102,500,000 to build. As noted in the *Chicago Daily Tribune*, the waterway was a "monument to the patience and persistence of the people of Illinois, who have refused to allow the project to be dropped, despite political inertia and stubborn opposition."[91] Dredging plus the retention of the old locks and dams at La Grange and Kampsville had provided a temporary 9' channel below Starved Rock. As a result, the waterway provided a navigable route all the way from Lake Michigan to the Mississippi River and beyond. On June 22, 1933, the waterway was officially dedicated.[92] A photograph from that date shows the first steel cargo shipment made up of 1,200 tons of steel sheet piling manufactured by Inland Steel Company of Chicago making its way from Chicago to New Orleans. On May 31, the Steamer VICKSBURG left New Orleans for Chicago with a tow of barges loaded with cargo from the lower United States and South and Central America. It was expected to reach Chicago on June 22.[93]

Work did not cease on the waterway after its opening. In 1935, the Rivers and Harbors Act included a recommendation that due to the upcoming decrease in the diversion from Lake Michigan, the original locks and dams at La Grange and Kampsville should be removed and new ones installed at Peoria and La Grange. The act followed the December 6, 1933 recommendation of the Chief of Engineers, who stated in order "to provide a fully useful commercial waterway," the channel should be altered to 9' deep and 300' wide below Lockport and that "modern" locks and dams be built at Peoria and La Grange.[94] The Peoria and La Grange locks and dams (with Chanoine wicket gates) were completed and opened for use in 1939.[95] Rathburn summarizes the state of the Illinois Waterway in 1939 in the historical report accompanying the 1996 survey of the waterway.

> As completed in 1939, the Illinois Waterway created a 300-foot-wide channel from Grafton to Lockport, except for the 2.5-mile canal at Marseilles, with seven locks (only five of which needed to be used during high water) providing a 110-

[89] "Illinois Waterway Will Be Ready for 1933 Season," *Engineering News-Record* 109, no. 14 (October 6, 1932): p. 402.
[90] Arthur Evans, "Open Waterway by March 1 or Bust! Is Slogan," *Chicago Daily Tribune*, January 22, 1933, p. 11.
[91] "41 Years in the Making," *Chicago Daily Tribune*, November 23, 1927, p. 8.
[92] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 90; Gude, "Illinois Waterway is Now Completed," p. 19.
[93] Photo, *Engineering News-Record* 110, no. 25 (June 22, 1933): p. 821
[94] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 91; USACE, *Annual Report*, 1934, p. 855.
[95] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 91, 95.

foot navigable width. Above Lockport, the sanitary and ship canal was a minimum of 160 feet wide for its entire length while the Cal-Sag only offered 60 feet of usable width. From the end of the sanitary and ship canal to Lake Michigan, the Chicago River was narrow and obstructed by many bridges. From the end of the Cal-Sag, the Little Calumet, Lake Calumet and the Calumet provided a 300-foot navigable width.[96]

In order to make the Chicago Sanitary & Ship Canal from Lockport to the Sag junction and the Cal-Sag from its junction with the Chicago Sanitary & Ship Canal to the Little Calumet River navigable by the vessels plying the Illinois Waterway, Congress approved a project to enlarge the channels to 225' in 1946. The work actually took place from 1955-58 and cost $125 million. The Thomas J. O'Brien Lock and Control Works was built as part of that project from 1957-60 to replace the Blue Island Lock and Control Works, which had been built on the Cal-Sag to regulate water coming from Lake Michigan down the Calumet River. The Blue Island Lock and Control Works site closed in 1967 after the Thomas J. O'Brien Lock and Control Works went online in 1965.[97]

By 1957, the Illinois Waterway encompassed the Illinois River from its mouth at the Mississippi River to the confluence of the Kankakee and Des Plaines rivers, a distance of 273 miles; the Des Plaines River from its junction with the Illinois River to Lockport, a distance of 18.1 miles; the Chicago Sanitary & Ship Canal from the South Branch of the Chicago River to Lake Street, Chicago, a distance of 34.5 miles; the Calumet-Sag Channel, Little Calumet and Calumet rivers extending from 12.4 miles above Lockport, Illinois, to Turning Basin 5 near the entrance of Lake Calumet, a distance of 23.8 miles; and the Grand Calumet River from its junction to 141st Street, a distance of 9 miles, and to Clark Street, a distance of 4.2 miles.[98]

Various maintenance projects and alterations have been undertaken on the waterway throughout its operation. Dredging took place regularly once the waterway opened for use to maintain channel depth. In 1962, for example, bottlenecks at Joliet resulted in a $10 million project to remove silt, debris and bed rock from a 4.5 mile stretch of the Des Plaines River.[99] Changes in barge use also spurred plans for altering the Illinois Waterway. As originally constructed, the waterway could accommodate barge tows made up of eight barges and measuring 105' x 600'. As traffic increased on the waterway and the barge tows expanded to fourteen and seventeen barges, congestion worsened on the channel. In order to move through the 110' x 600' locks, the barges had to be broken up, costing time. Plans were made to construct auxiliary locks measuring 110' x 1200' at Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock and La Grange in 1962. The state also developed the "Through and Across Joliet" plan in 1971 that would have removed the Brandon Road Lock and Dam and Lockport Lock and run the waterway north of Joliet to two lift locks located 2 miles north of Lockport. The Vietnam War effectively put a stop to all plans.[100]

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[96] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 95.
[97] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 98.
[98] USACE, *Annual Report*, 1957, p. 1265. See HAER No. IL-164, Drawing 2 of 7 for map of waterway.
[99] "Flood Work Bids High, Sanitary District Says," *Chicago Daily Tribune*, July 22, 1962, p. H1.
[100] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 98-102.

A major rehabilitation of the locks and dams took place in the 1980s. The first occurred at Starved Rock in 1983, followed by Dresden Island, Lockport, and Brandon Road from 1984-85. Peoria and La Grange were rehabilitated from 1987-88, and Marseilles was the last in 1988. An additional rehabilitation project was undertaken in 1995 at Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock that included resurfacing the walls and repairing and replacing the lock gates.[101]

CONSTRUCTION AND DESIGN INFORMATION

The *Engineering News-Record* extolled the virtues of the waterway in a February 11, 1926 article, stating "there are few waterway structures which have been more studiously designed than the locks, dams and power development of the Illinois Waterway." The "high character" of the construction coupled with the expert design work would result in Illinois having a "waterway of excellent engineering design and construction" despite the many delays.[102]

The design and construction of the waterway was initially planned and directed by the Waterways Division of the Illinois State Department of Public Works and Buildings, F.I. Bennett, Director of Public Works. W.L. Sackett served as Superintendent of Waterways. M.G. Barnes was the Chief Engineer of the Waterways Division with L.D. Cornish as Assistant.[103] The steelwork for the locks was manufactured according to the specifications of the American Bridge Company, while the reinforced concrete used throughout the waterway followed those developed by the American Engineering Societies' Joint Committee on Concrete and Reinforced Concrete Design.[104]

Features of the Panama Canal were adapted for use on the Illinois Waterway, not surprising given that Barnes and Cornish had both worked on the Panama Canal's design. Barnes, who had previous experience working for the New York Board of Water Supply and four years of service on the Advisory Board of Consulting Engineers for the Improvement of State Canals, was an assistant engineer who worked on the design of the Panama Canal's locks. Cornish was a "former Federal employee who had worked on the design of the Gates of Panama." The Panama Canal's influence on the design of the Illinois Waterway can be seen in a 1919 memo from M.G. Barnes to Col W.V. Judson, the U.S. District Engineer at Chicago. Barnes stated that he had been "informed that a lock has been built at Louisville, Kentucky, following somewhat the lines of the Panama design with certain changes that are of interest. I take the liberty of applying for a set of plans of this lock through your office."[105] Features of the Panama Canal were adapted for

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[101] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 104-105.
[102] "A Tranquil Waterway," *Engineering News-Record* 96, no. 6 (February 11, 1926): p. 226.
[103] "Illinois State Waterway for Barge Navigation," p. 1098.
[104] Barnes, "The Illinois Waterway," p. 180.
[105] C.R. Andrew, "Memorandum for the Files, Subject: Illinois Waterway, Some Items of Historical Interest which are Buried in the Files," June 15, 1949, in Folder 285/68b, File #5, U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago; letter from M. G. Barnes, Chief Engineer Illinois Waterway to Col. W.V. Judson, U.S. District Engineer, Chicago, November 7, 1919, in Folder 285/68b, File #2, in U.S. Army Corps of Engineers, Rock Island District, Organization and Organization Charts Six Foot Channel Project 1921, RG 77, NARA, Chicago; Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, p. 70.

use on the Illinois Waterway, such as the original lock gate operating machinery, which was a modified version of that invented by Edward Schildhauer of Chicago for the Panama Canal. Another example is the horizontal framing dimensions of the lock gates, which were the same as those on the Panama Canal.[106]

One major issue the engineers had to consider when designing the waterway was ice. The water from Chicago was used for "domestic, manufacturing, and sewage purposes" which led to "relatively warm water flowing down the waterway." This warmer water was cooled by the air as it ran down the waterway route and by the colder tributary water entering the channel at various points. This resulted in the formation of "continuous fields of floating ice" and ice gorges that backed up the waterway and caused flooding. Due to these icy conditions, the waterway had to be closed for portions of the winter in the early years of operation.[107] It also resulted in such features on the dams as air bubblers and boilers located on top of the dams to keep the gates operational even in freezing conditions and ice chutes.

While each site contained a lock, dam, control station and various auxiliary structures, modifications had to be made to accommodate each site's particular topography and location on the waterway. Specific information regarding each lock and dam site can be found in the individual HAER reports for each site, the list of which is provided at the beginning of this report. General information about the design and construction of the waterway and its locks and dams is included below.

State of Illinois, Lock Design and Construction
The Army Corps of Engineers had developed a 110' x 600' lock with miter gates on the Ohio River, appropriately known as the Ohio River Standard Navigation lock, which was chosen for use on the Illinois Waterway. The main components of any lock are the chamber, gates, and a system of valves and culverts regulating the water in the chamber. The chamber is a rectangular basin with side walls that allows "communication…between two pools of different level by admitting water from the upper pool through conduits and discharging it into the lower pool at the lower end."[108] On the Illinois Waterway, the chamber measured the Ohio River Standard Navigation size of 110' x 600' and had reinforced concrete walls. The chamber originally had mooring bitts embedded in the walls to which barges could tie during watering/dewatering operations. The Army Corps has since installed floating mooring bitts that move up and down a track with the level of the water. Stop log recesses are also located in the chamber walls near the lock gates. Crews could slide stop logs in these recesses to dewater the area around the gates as necessary to make repairs and perform basic maintenance.

Lock gates could take one of several forms: rolling gates, single swinging gates, tumble-gates, vertical lift gates, and miter gates.[109] On the Illinois Waterway, steel miter gates were used,

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[106] Cornish and Smith, "Engineering Features," pp. 187-188; Barnes, "The Illinois Waterway," pp. 181-182.
[107] "Illinois State Waterway," p. 1098; Barnes, "The Illinois Waterway," p. 181.
[108] B.F. Thomas and A.D. Wyatt, *The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams* (New York: John Wiley & Sons, 1905), p. 146.
[109] Thomas and Wyatt, pp. 174-175.

except at Lockport where a vertical lift gate was built and Thomas J. O'Brien where sector gates were used. William McAlpine, a graduate of the Massachusetts Institute of Technology in 1896 and an engineer with the Army Corps, is credited with designing the miter gate in 1913. A pair of miter gates consisted of a "pair of symmetrical leaves, movable about a vertical axis, shutting against each other at one end and against the miter sills at the bottom and abutting against the hollow quoin at the other end."[110] On the Illinois Waterway, leaves measured 7' wide x 65' long, ranged in height from 20' to 59' and weighed 60 to 350 tons. The leaves were constructed of a bracing frame made up of horizontal girders and five sets of diaphragms positioned vertically for stiffening. On the downstream side of each leaf was a "single steel skin of plating." At Lockport and Brandon Road, however, a "double skin" was installed on the bottom of the leaves "in order to form a buoyancy chamber and thus reduce the bearing stress on the pintle and yoke pin."[111] The operating machinery for the miter gates was the "so-called bull-wheel type," which Edward Schildhauer invented for the Panama Canal gates. An article described the machinery in detail:

> The machine consists of a large gear wheel revolving in a horizontal plane, with a vertical pin near the periphery of the wheel, to which a strut is connected, the other end being pinned to the gate. The wheel is revolved through an arc of about 197 degrees by means of a pinion engaging the teeth on its rim, which is in turn connected by a train of gears to a motor.[112]

The machinery was housed in pits within the lock's walls. In the 1980s, the Army Corps replaced the gate operating machinery with sector gears driven by hydraulic cylinders. The cylinder piston pushes a geared rack that engages the sector gear, which is fitted with a rigid sector arm that is pinned to the gate strut arm. The arms rotate and move the lock gate to an open or closed position.

Lock gates rest on miter sills (generally wood in early locks) located well below the depth deemed suitable for navigation. The pressure of the gate on the sill helped prevent water leaking from the chamber, while the sills themselves created an "elastic cushion for the bottom of the gates."[113] The initial design of the miter sills on the Illinois Waterway called for an innovation: a bronze spring was to be installed on top of the wood sill to minimize the pressure of the gate on the sill. According to the *Engineering News-Record*, the Illinois Waterway design removed "the uncertainty of stresses…since the bearing spring can transmit to the sill only the pressure due to the water in contact with the spring."[114] The gate anchorages, which connected the gates to the lock walls and distributed the thrust of the gate, were another unique feature. The anchorages

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[110] McAlpine was the Head Engineer of the Division Engineer Office, St. Louis, from 1929-33, then went to Washington, DC where he was in charge of the Engineering Section of the Office of the Chief of Engineers. McAlpine could be considered the "nation's expert in river improvement and flood control" at that time. See William Patrick O'Brien, "Upper Mississippi River 9-Foot Channel Project History, (Locks and Dams 3 Through 10)," HAER No. MN-20, 1987, p. 14; Thomas and Wyatt, *The Improvement of Rivers*, p. 174.
[111] "Illinois State Waterway," pp. 1097-98; Cornish and Smith, "Engineering Features," p. 182.
[112] Cornish and Smith, p. 187.
[113] Thomas and Wyatt, pp. 155, 157-158.
[114] Barnes, "The Illinois Waterway," pp. 181-182; "Illinois State Waterway," p. 1098; Thomas and Wyatt, *Improvement of Rivers*, pp. 157-158.

consisted of 24" Bethlehem I-beams with pressure distributing angles riveted into the back that were set into the concrete chamber walls.[115]

Lock chambers are generally watered by culverts in the walls or floor that are operated by valves run by machinery located within or on top of the lock walls. The principle requirement of any valve and culvert system is allowing "equalization of levels in a reasonable time" while not creating "dangerous water disturbances in the locks or approaches" and not allowing "excessive waste through leakage." The designers of the Illinois Waterway looked to the Panama Canal as well as the locks on the Ohio River to determine the number and size of the openings needed to fill and empty the locks efficiently and safely. As described in *Gateways to Commerce*, the lock chambers of the Ohio River locks had "small culverts passing directly through the lock's river wall above and below the dam" that were each controlled by a valve.[116] The final design for the Illinois Waterway called for six rectangular ports above "the transverse axis of the lock" and four rectangular ports below extending from the main culvert and arranged along the bottom of each chamber wall. This arrangement was decided upon by waterway engineers because "the drift from each group will be approximately equal in intensity and, when filling will be toward the center of the lock, thus automatically centering the vessel in the lock chamber so it will not drift toward the miter gates. When emptying the chamber the drift will be away from the center but with large boats or fleets of barges the drift efforts from the two groups will tend to neutralize each other."[117] Rather than locating the ports and valves in vertical openings, like those on the Panama Canal, the waterway's engineers decided to specify horizontal openings, resulting in an estimated savings of $25,000 a lock. The difference in size between the smaller ports and larger culvert diameter was planned in accordance with the Venturi principle, which states that the pressure of water is increased by movement through a constricted opening. Testing had showed the use of a 12' diameter culvert resulted in equalizing levels being reached in 7 to 12 minutes. Water was drawn into the culverts from the upper pool via rectangular intakes that were screened to prevent debris entering and clogging the culverts.[118]

Valves located in recesses in the chamber walls regulated the flow of water through the culverts. Described as the "wagon-body type" in contemporary descriptions, the valves were constructed from 18", 55 pound I-beams with wheels and roller bearings.[119] The Hyatt roller bearings helped "reduce the friction due to water pressure." Buckle plates were located on the upstream face. A 1-1/4" x 1-1/2" strip of rubber attached to the bottom of the gate formed the bottom seal when bearing down on the T-bar. The side seals were formed by steel plates with beveled edges. The top seal consisted of a rubberized fabric hose that came into contact with an inverted T-bar attached to the masonry. The valves could be raised 10' in one minute by chains and wire rope connected to a 10 hp electric motor at 60 rpm through a drive and gears that turned a drum. The valve operating machinery and electric motor were originally located in wells in the chamber

[115] Cornish and Smith, "Engineering Features," p. 184.
[116] O'Brien, Rathburn, and O'Bannon, *Gateways to Commerce*, p. 87.
[117] Cornish and Smith, "Engineering Features," p. 179.
[118] Barnes, "The Illinois Waterway," p. 180; Cornish and Smith, "Engineering Features," pp. 178-182.
[119] Earlier plans had considered using "counterweighted valves of the Stoney type" but were abandoned in favor of the simpler vertical lift type. See Cornish and Smith, "Engineering Features," p. 181.

walls.[120] In 1969, hydraulic machinery was installed above ground next to the valves it operates to replace the original equipment. The 1996 survey of the Illinois Waterway states that Tainter valves were used to regulate the flow of water in the chamber culverts. Tainter valves were used on the Upper Mississippi River project which was also under the purview of the U.S. Army Corps but the evidence supporting their use on the Illinois Waterway is conflicting. Drawings of the valves clearly show a vertical lift-type gate as described by Cornish and Smith. Contracts for work found in the National Archives do include references to replacement of the hoisting cables used on the "Tainter valves," further complicating the issue.[121]

State of Illinois, Dam Design and Construction

The Illinois Waterway had movable dams to regulate the pools between the locks, which are characterized as having gates that can be raised or lowered as needed. Three types of gates were studied for use on the Illinois Waterway: shutter, Stoney and Tainter gates. The state decided upon the Tainter gate. All of the dams featured a "concrete weir of moderate height with piers at certain intervals with a movable gate placed between each two piers that may be opened during flood periods." The four lower dams would be equipped with a 30' ice chute and Tainter gates to keep the pools level. To keep the gates clear of ice, dam boiler houses were located on top of the dams where icing was an issue, such as at Dresden Island, Marseilles and Starved Rock. The head gates were all 14'-15' wide and varied in number and height at each site.[122]

Capt. Marshall Lewis developed the predecessor of the Tainter gate in 1827 with his patent improving the "common paddle gate." Lewis' design was a "semi-circular, cast-iron gate turning on pivots connected to the gate by arms." Similar designs were patented by George W. Hildreth of Lockport, New York, and George Heath of Little Falls, New York, in 1840 and 1841, respectively. The Tainter gate took its current form in 1886 when Theodore Parker made refinements to a segmental arc gate for use on movable dams. Parker sold the rights to Jeremiah Burnham Tainter, a structural engineer from Wisconsin who patented the Tainter gate. The U.S. Army Corps of Engineers first used the Tainter gate on the Rock River in Illinois in 1889. Tainter gates were quite popular in dam construction because they were royalty free and inexpensive to build, particularly as compared to roller gates (which consist of a cylinder that rolls up and down inclined tracks located in the flanking piers).[123]

Tainter gates, in section, look like pieces of pie, with the point facing downstream and the curved edge facing upstream. The curved edge is covered by a stiffened skin plate. Tainter gates were originally constructed of wood, but by the time the Illinois Waterway was being constructed, steel was used for the framing and skin plate. Radial arms extend from the ends of the cylinder section and meet at the trunnion, forming a triangle. The trunnion is a fixed horizontal axis

[120] Cornish and Smith, "Engineering Features," pp. 181-82, 186; Barnes, "The Illinois Waterway," pp. 182; "The Illinois State Waterway," pp. 1096.
[121] William Patrick O'Brien, " Upper Mississippi River 9-Foot Channel Project History, (Locks and Dams 3 Through 10)," HAER No. MN-20, 1987, p. 21, who cited "The Upper Mississippi River Canalization Improvement," St. Louis: U.S. Division Engineer, UMVD, 1938, revised May 1939, May 1940 [typewritten]. Tainter valve references were found in Folder 821.13 (Lock Gates & Machinery) Cables 1936-37 and Folder 821.13 (Lock Gates and Machinery) 1932-41 in U.S. Army Corps of Engineers, RG 77, NARA, Chicago.
[122] Cornish and Smith, "Engineering Features," pp. 175-76; Weeks, p. 233.
[123] O'Brien, Rathburn, and O'Bannon, p. 76.

connecting to the piers flanking the gate on which the Tainter gate rotates. A motor drove the counterweight, which released the gate up and down. The "shape of the gate was such that the water pressure behind the gate had little effect, and the hoist machinery merely had to overcome the disadvantage of the gate," making the Tainter gate quite effective and inexpensive to construct. In some locations on the Illinois Waterway, submergible Tainter gates were installed that could be completely lowered down into a recess in the floor. At Marseilles, submergible Tainter gates helped ice flow, while at Peoria and LaGrange the gates worked in tandem with the wicket gates to better regulate water levels. Since the Brandon Road Dam maintained the waterway level as it ran through Joliet, electric hoist machinery was used to operate the Tainter gates.[124]

U.S. Army Corps Lock and Dam Alterations and Construction

When the U.S. Army Corps of Engineers assumed authority over the waterway from the state, the waterway was about 75 percent complete with the individual locks and dams in various stages of completion.[125] The Army Corps made some alterations to the original state design in response to design and material problems.

One alteration made by the Army Corps was the choice of material used for the pin, pin bushings, pintles and pintle bushings in the lock gates and the pins and bushings in the Tainter gate arms. The state design specified the use of Monel metal, but testing had revealed a problem with seizing. The Army Corps experimented on the lower gates at Marseilles and determined that nickel steel with phosphor bronze bushing was the "most suitable" material. Originally, the state had also considered that combination, but after seeing the problems the Sanitary District had with the bronze crystallizing and then failing (probably due to a chemical reaction with the water), they changed the specifications to Monel metal. What the state did not know (but was revealed with further investigation) was the Sanitary District actually used a copper/zinc combination whereas the federal government specifications called for bronze with no zinc. The Army Corps found the steel/bronze combination "satisfactory." Another change at Marseilles and the other lock gates was the replacement of the original 8" diameter pintles in the upper gates with 16" steel pintles and the installation of pintle air compartments to relieve pressure.[126]

The Army Corps also redesigned the lower miter sills, because "when the United States assumed control it was found that the design for the lower miter sills appeared to have not allowed for possible upward water pressure between the rock and concrete." Miter sills at Brandon Road had not yet been constructed so the design change was easily made there, but at Starved Rock, Marseilles, and Lockport, the lower sills had to be strengthened by drilling into the floor above the sill as well as the sill itself. Heavy bolts were inserted and then put under 23,000 pounds of

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[124] Tweet, *History of the Rock Island District Corps of Engineers*, p. 105; William P. Creager, Joel D. Justin & Julian Hinds, "Earth, Rock-Fill, Steel and Timber Dams," Volume III, *Engineering for Dams* (New York: John Wiley & Sons, Inc., 1961), pp. 893-894; O'Brien, Rathburn, and O'Bannon, *Gateways to Commerce*, pp. 73-76. For more information on roller gates, see *Gateways to Commerce*, Chapter VII, "From Rollers to Tainters: The Changing Technology of the 9-Foot Channel Project."

[125] C.R. Andrew, Memorandum for the Files, Subject: Illinois Waterway—Some Items of Historical Interest which are Buried in the Files, June 15, 1949, pp. 3-4, in Folder 285/68b, File #5, in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.

[126] Andrew, Memorandum, p. 5.

tension initially. The lower sills were later altered again to accommodate the design of a new emergency dam after the first one, which was installed at Starved Rock, failed.[127]

The cables used to operate the valve gates located within the lock walls had to be replaced by the Army Corps too. The original hoisting cables, made of wrought iron, had already been replaced in 1934 with wire rope hoisting and bridle cables. Just two years later, however, the cables were found to be fraying and in danger of failing. John A. Roebling's Sons Company, who supplied the wire rope, inspected all the valve cables and installed replacements.[128] There were also problems with the original valve gates. The emptying valves failed at Brandon Road, so the Army Corps had them removed and inspected in 1940. In 1941, the culvert valve gates failed at Lockport and Brandon Road, because the chains were not strong enough to withstand the pressure of the water emptying out of the lock chamber. The chains were replaced with cables. In 1945, the Army Corps contracted the American Bridge Company of Chicago to supply the lock culvert valve gates. The main roller-bearing assemblies were supplied by Chicago Gear Manufacturing Company of Chicago.[129]

In addition to making some alterations and completing the construction of the auxiliary buildings at the lock and dam sites, including the lockkeeper's residences, machinery shelters, stop log recesses on the locks, control houses, and tow-haulage units, the Army Corps also built two additional locks and dams: one at Peoria (completed 1938) and one at La Grange (completed 1939). A.F. Griffin of the U.S. Army Corps designed the Peoria and La Grange dams and incorporated Chanoine wicket gates rather than the Tainter gates used on the waterway's earlier dams. The Army Corps had experience with constructing and operating Chanoine wicket gates, as seen on the Ohio River at Davis Island Lock and Dam built in 1878.[130] A wicket dam was also built on the Kanawha River in West Virginia in 1905.[131] Chanoine wicket gates rendered the dam not just movable but also navigable when the gates were lowered. Navigable dams were used in those areas where extended periods of open river navigation were possible, such as at the lower end of the Illinois Waterway where Peoria and La Grange were located.[132] They were also recommended for use on large rivers where rapid flooding was a possibility because they were "not easily disabled, can be maneuvered rapidly" and did have "many loose parts" unlike other

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[127] Andrew, Memorandum, p. 5.
[128] Folder 821.13 (Lock Gates & Machinery) Cables 1936-37, in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.
[129] War Department, U.S. Engineers Office, Culvert Valve Gates, Joliet Area, March 5, 1941, and E.H. Beechley, Principal Engineer to the District Engineer, Chicago, Subject: Repairing valve gates, all locks, Joliet Area, June 22, 1940, both in Folder 821.13 (Lock Gates and Machinery) 1932-41. For valve gate and roller bearing assembly contracts, see Folder 821.13 (Ill Wwy) Gates P.O. 41386, 1945 and Folder 821.13 (Ill Wwy-Roller Bearings) W-11-032-Eng-1976, 1945. All folders in U.S. Army Corps of Engineers, Chicago District, RG 77, NARA, Chicago.
[130] See "Davis Island Dam, Lock Number 1," HAER No. PA-65.
[131] Thomas and Wyatt, p. 232.
[132] O'Brien, Rathburn, and O'Bannon, *Gateways to Commerce*, p. 41. They also point out that non-navigable dams, such as those found elsewhere on the waterway, were able to allow "accurate regulation of pool heights" since they had more flexibility in opening than wicket gates, which could only be fully raised or fully lowered. In addition, "the higher sills of non-navigable dams also ensured a minimum pool level." Wicket gates were more costly to maintain and operate. These factors caused the Army Corps to ultimately replace the Ohio River's wicket gates with roller and Tainter gates.

types of dams. The rapidity with which the wickets could be opened was seen as another advantage.[133]

The design precedent for the Chanoine wicket can be found in "gates with horizontal axes fixed in the abutments" as found on dams on the River Orb in southern France, which consisted of "shutters supported by hinges fastened to the floor." French engineer M. Thenard modified this design by adding a prop, hurter and tripping bar. Jacques Chanoine, a French engineer, further altered it in 1852 when he "raised the axis of rotation to near the middle of the wicket, creating a type which has remained almost unchanged."[134] Originally Chanoine had experimented with putting the axis at a point about 1/3 or 1/2 of the length of the wicket above the sill. As the level of the pool rose, the pressure of the water would shift the center weight above the axis causing the wicket to automatically fall down. The water would then pass over the wicket until the water level had lowered to such a point where the gate could swing back upright. The design proved too sensitive to changes in the water level, so Chanoine experimented with raising the axis, but to no avail. His solution was to design the gates to be manually operated.[135]

The Chanoine wicket gate consists of a row of wooden shutters (also called leaves). Each wooden shutter is supported by a framework known as a "horse" that contacts the back of each shutter at nearly the center point. The horse creates a horizontal axis of support that keeps the shutter upright at a slight angle. The part of the shutter above the axis is known as the "head" or "chase" and that part below is known as the "breech" or "butt." The horse and shutter are kept upright by a long prop that extends at approximately a 45 degree angle from the back of the shutter to the hurter, a structural framework located on the dam's floor.[136]

On the Illinois Waterway, the wickets were kept lowered during extended periods of high water. If necessary, the wickets were raised mechanically by personnel on maneuver boats. The basic process of lowering the gates involved dislocating the prop end, which then caused the pressure exerted by the water to push the shutter down on top of the hurter, prop and horse. To raise a wicket dam, the shutters were lifted so the prop fell in place.[137] Rathburn describes the process at Peoria Dam:

> Positioning the port side of *Maneuver Boat No. 2* against the upstream side of the dam, the crew attaches a metal hook to the underwater gate by hand and then connects the other end of the hook, its eye, to the steam-operated gate-lifter crane permanently mounted on the boat. The gate-lifter operator then pulls the gate up into a vertical position. A diagonal prop, braced out from the wicket on the upstream side by a 'horse,' holds the gate in place. Once this is done, a winch, called the return engine, pulls the boat into position to lift the next wicket in

[133] Thomas and Wyatt, p. 239; Wegmann, *Design and Construction of Dams*, p. 331.
[134] Thomas and Wyatt, *Improvement of Rivers*, p. 227.
[135] Thomas and Wyatt, *Improvement of Rivers*, pp. 227-229.
[136] Detailed descriptions of Chanoine wicket dams are available in Thomas and Wyatt, pp. 227-232 and Wegmann, pp. 327-331.
[137] See Wegmann, p. 330, Thomas and Wyatt, p. 231.

> line....The same procedure used for raising the dam is used in reverse for lowering it when water levels rise sufficiently.[138]

Peoria and La Grange dams were altered in the late 1980s to accommodate the installation of Tainter gates at their landward ends, but the majority of the wicket gates remain in place. These wicket dams remain as some of the last of this type in the United States.

The last major addition to the waterway was the construction of the Thomas J. O'Brien Lock and Control Works on the Calumet-Sag Channel, which opened for use in 1965. The lock chamber was the largest on the waterway at 110' x 1000'. The biggest modification was the use of sector gates rather than miter gates. The Army Corps chose to use sector gates at the lock rather than the miter gates predominantly used elsewhere along the waterway because sector gates could continue operating even in reverse flow conditions, which occurred on the Cal-Sag when its level was above that of Lake Michigan. The steel framed sector gates (each of which has a 61' radius) look like wedges of pie in plan. The curved surface of the gate has a steel skin and faces upstream. It rotates much like a miter gate on a vertical axis consisting of a two-part hinge. In the open position, the sector gate is housed within a recess in the chamber wall. Hydraulic machinery operates the gates and is housed in a pit near the gate it controls.[139]

U.S. Army Corps, Pool Construction

The other major undertaking by the Army Corps on the Illinois Waterway involved dredging the pools created by the dams along the waterway. The state had put together a dredging fleet, consisting of a small dipper dredge, two steel barges, and a tow boat (all with steel hulls) at a total cost of $350,000. They contracted the Congress Construction Company to dredge the pools using this fleet at a rate of $1 a cubic yard for dirt and $4 a cubic yard for rock.[140]

The Brandon Road Pool between Lockport Lock and the Brandon Road Lock and Dam required dredging the rock from the upper portion of the channel a distance of 6,000' to create a 160' wide and 20' deep channel. The next 5,500' of channel was dredged to a 10' depth and a 160' width. The channel then joined the Des Plaines River improvements undertaken by the Sanitary District of Chicago that extended to the McDonough Street Bridge in Joliet for a total distance of 6 miles. A dam located on the Des Plaines River above the Jackson Street Bridge in Joliet formed the "upper basin" of the Illinois & Michigan Canal was removed after Brandon Road Lock and Dam had been completed. A distance of 5,500' on the Des Plaines River from the Elgin, Joliet & Eastern Railroad bridge to the upper basin had to be dredged, creating a 240' wide and 5' deep to 140' wide and 7.5' deep section. Between McDonough Street and the Brandon Road Dam, the channel widened "between concrete walls, now nearly completed, until a width of some 1700 feet is reached just above the dam." Concrete retaining walls measuring

[138] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume I, pp. 91-92.
[139] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume 2, pp. 21-22; William J. Santina and E.G. Hoffman, "Calumet River Lock, Calumet-Sag Project, Illinois," *Journal of the Illinois Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers* Paper No. 1642, WW3 (May 1958): p. 1642-6.
[140] Army Corps, "Illinois Waterway," p. 53.

15' to 40' tall had to be constructed to contain the pool as it ran through the city of Joliet to prevent flooding. Seven bridges, including two railroad bridges, were located over the pool.[141]

Next was the Dresden Island Pool, extending from Brandon Road Lock and Dam to Dresden Island Lock and Dam for a total of 14 miles. In some places the pool was just 200' wide. It was expected that 206,000 cubic yards of dirt and 2,700 cubic yards of rock would be dredged. Bridges at Treats Island and Smith's Highway crossed the pool, and the state had planned to replace them with fixed spans and also construct a new one just below Brandon Road Lock to carry Brandon Road Highway over the waterway.[142]

The 24 mile long Marseilles Pool stretched from Dresden Island Lock to the Marseilles Dam. Four bridges were located over the pool, two of which were railroad bridges, and all of which required modification to allow navigation on the waterway. Dredging was required to create a 150' wide and 8' deep channel and was expected to result in the removal of 393,000 cubic yards of dirt and 26,800 cubic yards of rock.[143]

Starved Rock Pool, located between Marseilles and Starved Rock locks, was 13-1/2 miles long with two bridges spanning it at Ottawa. Engineers estimated it would require dredging of 36,000 cubic yards of dirt.[144]

OPERATIONS

The process of locking through a boat is simple. If the barges are at the downstream end of the lock heading upstream, the upstream gates are closed while the downstream ones are opened. The barges are then moved into the chamber and the downstream gates closed. Water is released into the chamber via ports located along the chamber wall that connect to a culvert. Intakes located outside the upstream lock gates let water into the culverts. The release of water into the chamber lifts the barges up to the level of the upper pool. The upper gates are then opened so the barges can be maneuvered out of the lock and into the upper pool. The operation is reversed for barges heading downstream.[145]

The waterway had been designed for use by "towboats pushing eight jumbo hopper barges." The jumbo barges each measured 35' x 195'. The configuration of the eight barge tow with towboat consisted of two rows of three barges tied together followed by a row of two barges tied together. The towboat pushed the three rows into position in the lock chamber, then moved alongside the first row of two barges during the lockage. The resulting configuration measured 105' x 600', which allowed all the barges to be locked through in one pass since the lock chamber conformed to the Ohio River Standard size of 110' x 600'.

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[141] Army Corps, "Illinois Waterway," pp. 43-44.
[142] Army Corps, "Illinois Waterway," pp. 47-48.
[143] Army Corps, "Illinois Waterway," pp. 49-50.
[144] Army Corps, "Illinois Waterway," pp. 51-52.
[145] See Thomas and Wyatt, *Improvement of Rivers*, p. 147.

By the 1950s, the fourteen barge tow had become the standard. While the Thomas J. O'Brien lock could handle the larger configuration since the chamber was 110' x 1000' and the fourteen barge tow was 105' x 985', the barge configuration had to be broken into two, known as "cuts," on the other locks. The first cut was made up of two rows of three barges tied together. The second cut followed the standard configuration used in the eight barge tow. Rathburn describes the locking through process with the fourteen barge tow configuration.

> After breaking the tow into these two cuts, the towboat pushed the first cut of barges through the lock, locked through with it, pushed the cut out of the lock, locked back through to get the second cut of barges, pushed it into the lock, moved over into the 'third barge slot' in the last row of the eight-barge configuration, locked through with the second cut, and then reassembled the two cuts into one united configuration and moved back into its pushing position.[146]

This process was time consuming and caused congestion along the waterway. In response to complaints from shippers, tow haulage units were installed in the 1970s at all the locks except Thomas J. O'Brien. These units were able to pull the first cut through the lock, so the towboat could remain in its position in the second cut, thereby minimizing some of the locking through time. The installation of the tow haulage units also allowed the use of seventeen barge tow configurations, which measured 105' x 1,118'. In this configuration, the first cut was made up of three rows of three barges. The second cut had two rows of three barges while the last row had two barges and a space for the towboat, just like the original eight barge tow configuration.[147] Although the construction of auxiliary locks measuring 110' x 1200' was authorized in 1962 to deal with the congestion, they were never built.

From the 1930s to the 1970s, the amount and size of the vessels using the Illinois Waterway increased. In 1934, commercial traffic on the waterway amounted to 104,750 tons and had increased by 1953 to 20 million.[148] Traffic on the waterway leveled in the 1970s but congestion

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[146] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume 1, p. 99.
[147] Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," Volume 1, pp. 100-102.
[148] Department of Public Works & Buildings, "132 Years of Public Service: The History and Duties of the Division of Waterways," (State of Illinois, 1955), p. 15.
Illinois Waterway traffic statistics are provided in the U.S. Army Corps of Engineers' Annual Reports. The information is presented in various ways throughout the 1930s. In 1931, the upbound traffic on the Illinois River (from La Salle to Grafton, IL) consisted of 128 steamers, 609 motor vessels, 21 sailing vessels, and 457 barges for a total of 1,215 vessels. The downbound traffic included 140 steamers, 515 motor vessels, 21 sailing vessels, and 400 barges for a total of 1,076 vessels. (USACE, *Annual Report*, Part II, 1932, p. 696.) By 1933, traffic had increased to a total of 2,140 upbound vessels at 341,760 tons, consisting of 50 steamers, 1,251 motor vessels, 772 barges, and 67 other types. Downbound traffic numbered 2,290 vessels at 344,249 tons, including 50 steamers, 1,282 motor vessels, 756 barges, and 202 other types. In 1934, the total numbers of vessels had declined but the tonnages increased, with upbound tonnage at 642,715 and downbound at 682,214. (USACE, *Annual Report*, Part II, 1934, p. 670 and Part II, 1935, p. 710.) In 1935, the statistics for the Illinois Waterway also included the Chicago Sanitary & Ship Canal and the Calumet-Sag Canal. The total tonnage was 1,361,280. On the South Branch of the Chicago River, 215,107 tons were carried. Total tonnage, including rafted traffic, was 1,584,428 tons worth $48,710,394. (USACE, *Annual Report*, Part II, 1936, p. 747.) In 1936, 1,537,759 tons were transported on the Illinois Waterway and 507,805 tons were moved on the South Branch of the Chicago River. The total tonnage was 2,048,057, including rafted traffic, for a total value of $54,725,585. (USACE, *Annual Report*, Part II, 1937, p. 781.) In 1937,

on both the Illinois Waterway and the Upper Mississippi River continues. According to a recently released study of the two systems dating to 2005, 51.6 million tons of commercial cargo worth $9.5 billion was transported on the Illinois Waterway. Together, the two systems move 60 percent of corn exports and 45 percent of soybean exports, in addition to coal, chemicals and petroleum.[149]

CONCLUSION

The Illinois Waterway is significant as an important transportation and shipping link connecting the Great Lakes to the Mississippi River and beyond and as a component of this country's inland navigation system. In addition, its locks and dams are significant as examples of the evolution of waterway engineering. The original lock and dam designs of Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock borrowed from the Panama Canal and early Army Corps work on the Ohio River while also responding to the challenges of each particular site. The dams at Peoria and LaGrange contain some of the last examples of wicket gates in this country. Finally, Thomas J. O'Brien, the last to be constructed, illustrates changing technologies in the use of cells for the lock walls and sector gates.

2,874,864 tons were transported on the Illinois Waterway and 698,329 tons on the South Branch of the Chicago River. The total tonnage, plus rafted traffic, equaled 3,575,299 tons worth $65,604,398. (USACE, *Annual Report*, Part II, 1938, p. 803.) By 1938, the total tonnage on the Illinois Waterway (which included the Chicago Sanitary & Ship Canal, Calumet-Sag Canal, and South Branch of the Chicago River) was 4,446,493, including rafted traffic, at a total worth of $109,008,794. (USACE, *Annual Report*, Part II, 1939, p. 863). From 1975-86, the amount of goods shipped on the waterway decreased from 48.5 million to 42.3 million. (Rathburn, "Architectural and Engineering Resources of the Illinois Waterway," p. 103).

[149] See Final Draft, "Re-Evaluation of the Recommended Plan: UMR-IWW System Navigation Study, Interim Report," issued March 2008, available at http://www2.mvr.usace.army.mil/UMRS/NESP/ (accessed March 2009).

Appendix A: Contracts Let on the Waterway, ca. 1930

Table showing contracts let on the Illinois Waterway as of 1930, from U.S. Army Corps of Engineers, "The Illinois Waterway," (Washington, DC: U.S. Government Printing Office, 1930), p. 56.

CONTRACT	CONTRACTOR	AMOUNT	PERCENT DONE
STARVED ROCK			
2. Lock and dam	Wood Bros.	$1,820,372.23	98.3
7. Metal work	Independent Bridge Co.	$772,592.20	82.6
8. Machinery		$80,000	
9a. Pool	Congress Construction Co.	$1,102,840	
MARSEILLES			
1. Lock	Green & Sons	$1,269,283.98	100
4d.	Independent Bridge Co.	$455,800 (est.)	0
8. Machinery		$80,000	
9b. Canal	Callahan Construction Co.	$848,267.95	85
9c. Pool	Congress Construction Co.	$792,762	75
DRESDEN ISLAND			
3. Lock and dam	Congress Construction Co.	$1,300,000	49.1
8. Machinery	Independent Bridge Co.	$80,000	
9d. Pool	Congress Construction Co.	$339,500	32.2
10. Metal work	Independent Bridge Co.	$476,543.74	62.6
BRANDON ROAD			
5. Lock and dam	Green & Sons	$2,163,249	72.8
6. Pool		$2,535,885	72
8. Machinery	Independent Bridge Co.	$80,000	
10. Metal work		$493,841.26	62.9
LOCKPORT			
4a. Excavation & Masonry		$1,353,907.83	100
4d. Miter gates & valves		$197,538.22	100
8. Machinery	Independent Bridge Co.	$84,500	

Appendix B: Maps

Figure I: Map from William A. Shelton, "The Lakes to Gulf Deep Waterway: I," *The Journal of Political Economy* 20, no. 6 (June 1912): pp. 541-573.

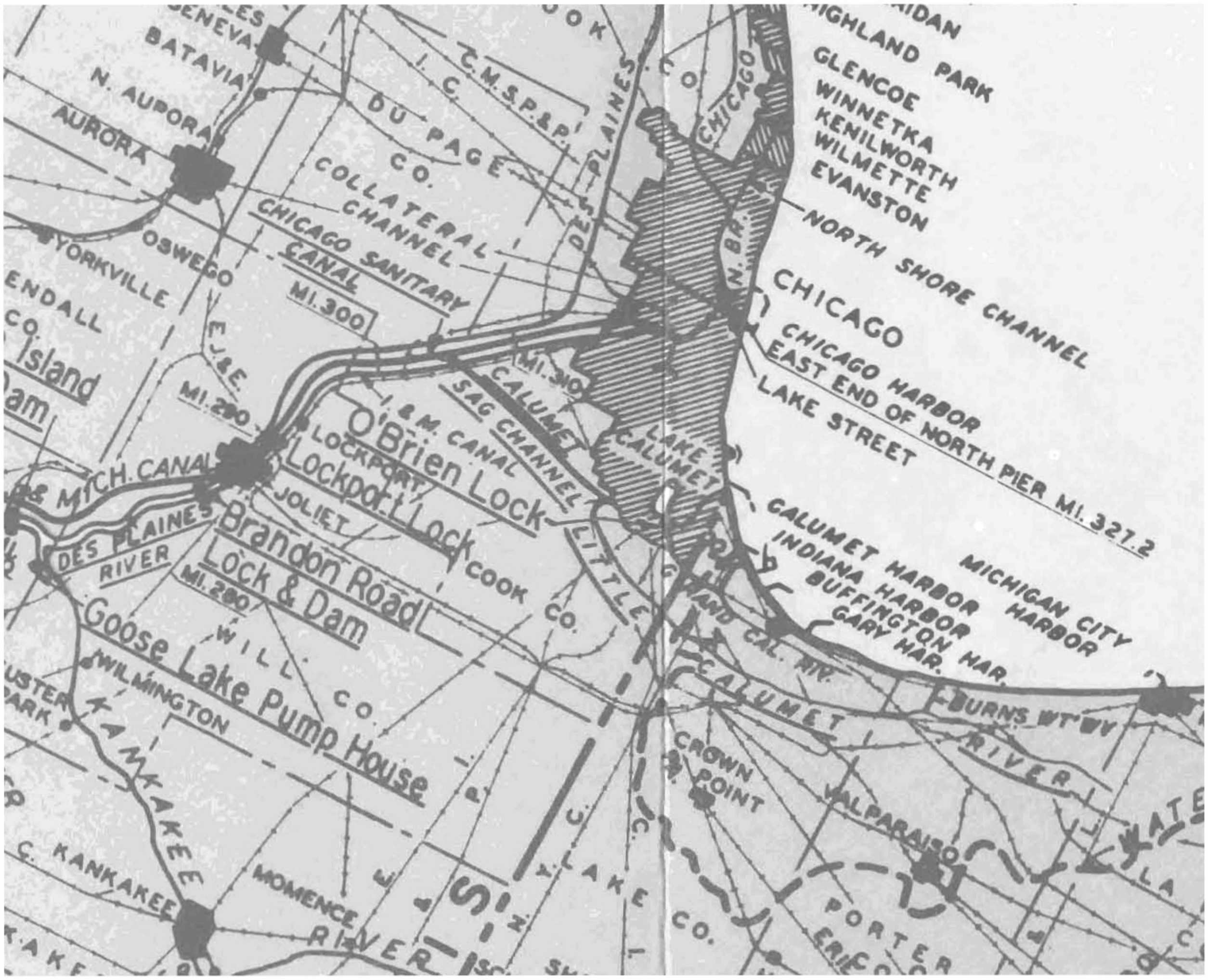

Figure 2: "Index Map, River and Harbor Works, Illinois Waterway," Chicago, Illinois District, U.S. Army Corps of Engineers, September 30, 1977.

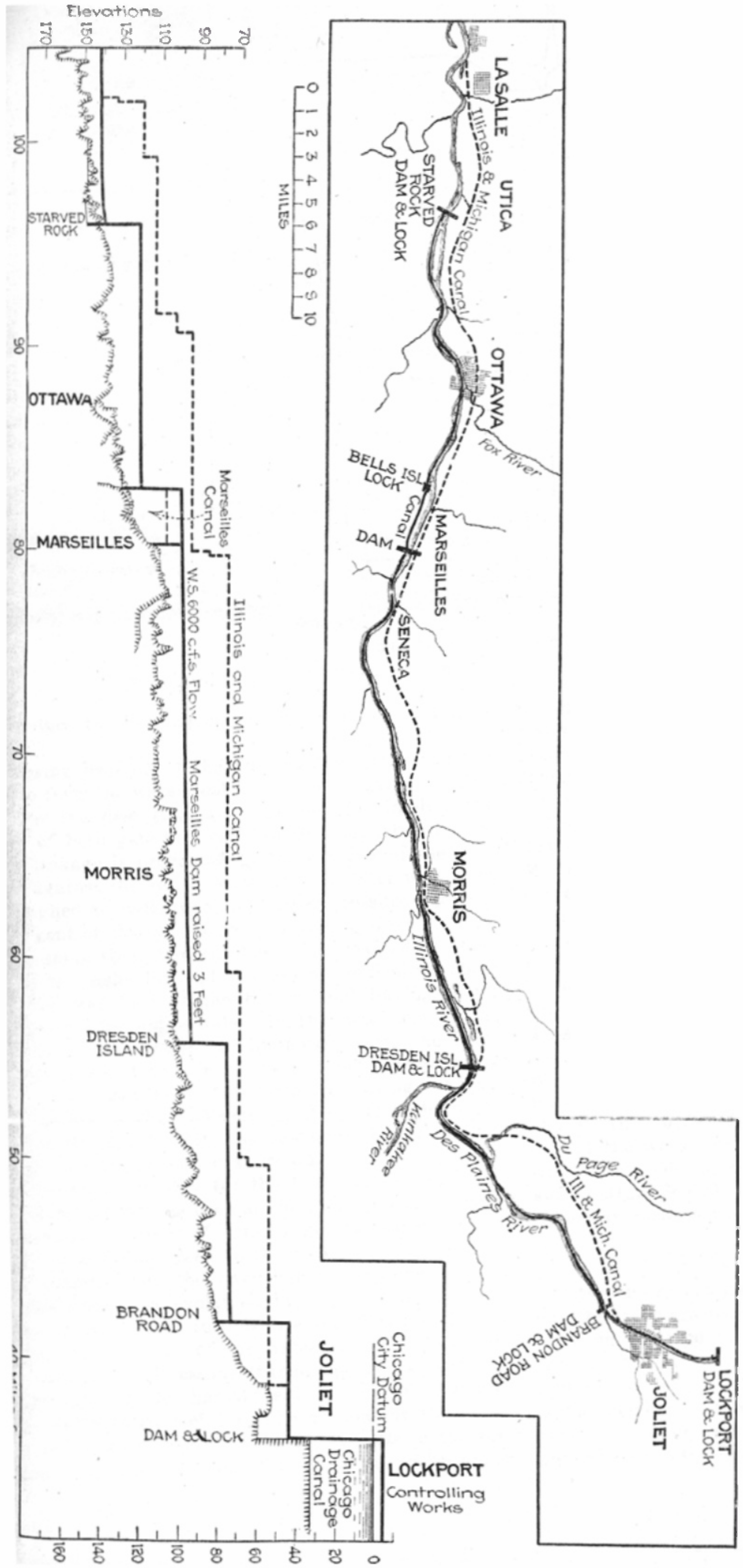

Figure 3: Map of waterway and profile as planned in 1920, from "The Illinois State Waterway for Barge Navigation," *Engineering News- Record* 85, no. 23 (December 2, 1920): p. 1097.

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